Food Security in an Insecure Future

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Abstract  Food security in the Middle East is directly affected by a challenging combination of ongoing destructive conflicts, a global economic downturn, widespread poverty, high population growth, corruption, intolerance, and the potentially damaging consequences of climate change. Many Arab countries demonstrate nearly all the features of those countries classified as poor, less developed, or failing to achieve the eight Millennium Goals. Even the economies of the richer oil-exporting countries in the Region have been seriously damaged by the downturn in oil and gas prices as new sources come on stream elsewhere and demand falls as a result of renewable sources of energy becoming available.

Keywords  Sustainable energy • Food security • Water management

Climate change predictions for the Region are worrisome even if most of the environmental commitments made by countries at the UN Climate Change Conference in Paris at the end of 2015 are delivered. Large parts of the Region already suffer from periods of extreme temperatures and shortages of fresh water, so harsher conditions of higher temperatures and weather extremes pose special problems for inhabitants and policymakers, with heightened geopolitical risks and uncertainties. Agriculture is especially vulnerable.

Modern agricultural technologies with improved cultivars and livestock breeds must displace poor agricultural and pastoral practices. Larger-scale, better-capitalised production units are required with policy shifts to remove market-distorting subsidies, tariffs, and other regulatory impedances. Agricultural “roadmaps” are needed to encourage the most appropriate crops and maintain livestock in the most appropriate places. The trading of meat, dairy products and many types of crops to water-poor regions can be regarded as an efficient way to
redistribute water. In unsettled times, food security requires protection of food-producing, food-processing, and food-distribution industries are protected along with research and development facilities, and the maintenance of skilled personnel.

There are doubts as to whether agencies of the United Nations, other international agencies, donor countries and charities are able to provide adequate humanitarian aid and humanitarian intervention to enable safeguarding of displaced peoples and ensuring the resumption of normal peaceful conditions essential for food security to be guaranteed. Promises of aid funds must become reality, followed by the establishment of functional supply and transport networks, and rapid transition to self-reliance thereafter. Food security and social stability are inextricably linked.

The solution to the food-security problems in the Region ultimately lies in the actions of governments, businesses and individuals. Governments need embedded scientific and technological expertise, strong civil-society institutions, integrity, and a particular focus on high-quality education.

Introduction

In a previous article (Hillman and Baydoun 2012), we considered definitions of food security in the modern era of rising global populations, discussing how food security might be attained in terms of security of water and fossil-fuel-derived energy supplies, climate change, rapid urbanisation, changing dietary trends, and modification of the natural environment leading to depleted natural resources, increasing environmental pollution, and the need to introduce modern technologies. The concepts of sustainable agriculture and uncertainty were also addressed, notably in respect of fresh thinking about key components of agricultural systems. These included (Babu and Blom 2014) vertical and horizontal integration of farming-related businesses to allow adequate capitalisation for enhanced efficiency measures; (Bardshaw and Brook 2014) policy shifts to remove market-distorting subsidies, tariffs, import and export bans, and excessive bureaucracy; (Baydoun and Hillman 2012) improved crop and livestock breeding, including entirely new species; (Bolukbasi et al. 2015) automation in agriculture and horticulture; (Breisinger et al. 2014) protected cropping; (Cong et al. 2013) new-generation agrochemicals; (Elasha 2010) new agronomic practices; (Fan et al. 2014) novel foodstuffs; (FAO 2011) habitat reconstruction and land renovation; (FAO 2015) biofuels and biodiesel; (Garland et al. 2014) periurban and urban agriculture; (Grebnier et al. 2014) industrial biotechnology; (Grivetti and Ogle 2000) farming the seas and oceans; (Hillman and Baydoun 2012) long-term carbon storage; and (Hillman and Baydoun 2015) new ways of thinking about carbon trading. More recently, we reviewed mitigation and adaptation processes and strategies to address the impacts of climate change on food, water, and energy security in the Arab Middle East (Hillman and Baydoun 2015).
Here, we consider potential adaptations to an insecure global future generally, and to the concerns in the Arab Middle East specifically, in the light of the economic realities of wide disparities in wealth, competition for resources, and widespread poverty in many parts of the globe, coupled to a relatively high population growth, on-going conflicts, attempted cultural genocides, potential conflicts, endemic corruption and nepotism, and epidemics of infectious diseases. Most Arab countries are classified as poor, less developed, or failing to achieve the eight Millennium Goals of the United Nations, and these Arab countries share several undesirable features (Table 1). Even the much richer oil-exporting Arab nations are under pressure. After a decade of relatively high oil prices, these nations have accumulated more $2.5 trillion in sovereign assets reinforced by substantial infrastructural investments supplemented by high levels of spending on imported military hardware. Now, however, oil prices are under pressure as global oil and gas prices slumped in 2014 and remain depressed, possibly for the medium to long term as new sources of oil and gas come from hydraulic fracturing (fracking) and from Iranian exports as the economic blockade on Iran is being relaxed, coupled to greater energy efficiency in industry and new sources of renewable energy. This price depression has exposed the degree to which the economies of these Arab oil exporters are dependent on oil and their failure in most instances to diversify their economies as their populations continue to expand alongside public expectations of continuing governmental largesse. Nearly all of the immediate adaptations Arab countries must undertake in order to adjust to a raft of severe insecurity issues require strategic planning and value-for-money infrastructural and civil-society improvements, and any preparatory changes in rural and urban areas will differ in scale and design. Longer-term adaptations will be reliant on more stable conditions and a stepwise improvement of educational standards and attitudes. At the time of writing, no Arab country is deemed to have acceptable levels of budget transparency according to the latest 2015 Open Budget Index released by the International Budget Partnership (see www.internationalbudget.org).

The future is especially insecure because of the persistence in the Region of a combination of incompatible political and economic ideologies, religious and ethnic groupings overtly intolerant of others, introvert nationalism and disrespect of others, disconnection from democratic principles, profound cultural divides, ignorance – some wanton, inability to adapt to modernity, and malevolent community and national leaders. From a noble history of toleration, hospitality, and learning, Arab society is fragmenting, defiled by the actions of relatively few. Arabs are killing Arabs either directly or indirectly; Arabs are inflicting as-yet-untold horrific crimes on other Arabs either directly or indirectly. Attacks on Arab countries by their neighbours might be used as an excuse to divert attention from their own failing donor-dependent economies or social structures, or most often to steal resources and ensure that the neighbouring country is suppressed from developing normally. At the global level, many would say that future conflicts and insecurity in much of the world are inevitable, simply because of the impacts of expanding global populations and the obvious competition for limited resources. The intensity of this competition must be analysed in context of the alarming
Table 1  Fourteen features of countries classified as poor, less developed, or failing to achieve the eight United Nations Millennium Goals. The listed features are closely interrelated

1. Poverty

Common in both the urban and especially the rural poor, poverty is sometimes concentrated in regions, often in marginalised ethnic or religious groups, and may relate primarily to girls and women. Many of the urban poor operate in the unofficial economy. The rural poor tend to be land-constrained, dependent on rain-fed, low-yield subsistence agriculture with little or no access to modern technology (modern cultivars and livestock breeds, fertilisers, pesticides, automation, agronomy advice, veterinary support), and usually do not own their land. The rural poor encounter barriers to trade (e.g. transport, storage) and are unable to meet quality assurance standards. With no or limited access to social benefits (primarily pensions, child support, education, training, and healthcare), the poor may be hungry, thirsty, suffer ill health and low standards of accommodation, and die early. The poor are susceptible to exploitation.

2. Hunger and thirst

Access to food and potable water may involve substantial travel on foot, and the basic requirements may only be met wholly or in part by humanitarian assistance. Food quality and safety are usually low, and cooking is often dependent on wood for fuel. Symptoms of malnutrition are prevalent.

3. Disease

Slum dwellings, insanitary conditions, poverty, and hunger lead to a vulnerability to pandemics, made worse by poor or no public health provision. High maternal and child mortality and low general life expectancy characterise poverty and there is a reliance on traditional and/or herbal medicine. Crops and livestock are subject to catastrophic attacks by pests and diseases.

4. Poor environmental management

Poor countries suffer a depletion of their natural resources, including freshwater supplies and native flora and fauna. Mineral and fossil-fuel resources are extracted to be exploited by industries in other more-developed countries. Land, water, and the atmosphere may be polluted with few or no remediation efforts. National, regional, and international environmental regulations are not properly implemented. Agricultural soils tend to be subject to erosion, salination, solarisation, desertification, and nutrient depletion. Even without climate-change predictions, the general anthropogenic environmental degradation currently taking place increases the vulnerability to flooding, sandstorms, ill health, and displacement of peoples. Most poor countries are enduring adverse climate trends, and climate-change predictions point to even harsher conditions (erratic rainfall with rising temperatures, heat waves, hot extremes, and storms; rising sea levels and acidification of seas and oceans; increased desertification with effects on agriculture as well as the natural flora and fauna; socio-economic and health implications).

5. Poor infrastructure

Quantity and quality of the built infrastructure tends to be low, or even absent (e.g. roads, ports, airports, telecommunications and access to the internet, hospitals and clinics, reliable power and fuel supplies, potable water sources, sanitation systems and sewage disposal, protected natural environments, cold and pest-free storage of agricultural and horticultural produce). The cost of living is worsened by relatively high overland transport costs. Facilities may be inadequate to meet demand and maintenance neglected. Rapid urbanisation and conflicts exacerbate infrastructural deficiencies.

6. Corruption

Political autocracy coupled to a lack of transparency in government and public services, a weak judiciary, lack of consultation on major issues, and suppressed media enable a climate of corruption and nepotism to permeate all areas of society, including schools, colleges, and universities. A low regard for human rights, democratic processes, health and safety measures, and international law, is made worse by an overburdensome bureaucracy (staffed by poorly paid civil servants and police) dependent on bribery to function. Corruption allows laws to be broken with impunity, and protests ignored. In most areas of society, a lack of altruistic leadership and

(continued)
charity is commonplace. Unsurprisingly, there is widespread malcontentedness at corruption and its effect on reinforcing inequality and impeding meritocratic advancement. Little effort is made to eliminate corruption without external pressures from donor countries.

7. Low GDP per Capita

Poor countries manufacture few value-added products, offer little or no advanced training, and lack participation in the global knowledge economy. There is little or no foreign direct investment and free trade is constrained. Financial assistance from donor countries is increasingly being audited to ensure compliance with attempts to prevent unauthorised expenditure. Many poor countries have not managed to have constructive relationships with potential donor countries, and some try to align themselves with one of the main international political power blocs. Unrelieved debt burdens have led to high interest rates on loans and difficulty of obtaining credit. Private savings are minimal and the country may be subject to periodic flights of capital. Their economies are grossly imbalanced with little spent on healthcare, education, and other social benefits compared with defence and vanity projects. The economy may be damaged by previous and/or ongoing conflicts, and may in any case have limited absorptive capacity properly to manage additional resource inflows and outflows. Agriculture, unofficial transactions, and remittances from those working abroad contribute disproportionately to the real economy.

8. Poor education

Limited or no access to free schooling accounts for a general low level of literacy and numeracy, especially of females. This is reflected in the absence of high-grade internationally competitive universities, colleges, and research institutes, despite a high level of parental financial sacrifice to secure a supposedly good education for their children. Science and technology tend to be poorly taught and there is undue influence of religions with regressive attitudes to modernity. A lack of investment in research and development (R&D) and a lack of a critical mass of scientists, engineers, and technologists impede industrial development, and prevent those that remain from joining international consortia, participate in learned societies, access essential literature and training programmes, and have the opportunity to use state-of-the-art instrumentation, software, and laboratory consumables. The best educated and the most talented and entrepreneurial usually emigrate, leading to a brain drain. Intellectual property rights are often ignored and little benefit is derived from traditional knowledge and its products tend to be exploited in other countries. Crucial demands and needs of less-developed countries are rarely the targets of major international R&D projects.

9. Gender inequality

Low educational attainment in most girls and women is reflected in female political, economic, and social representation and participation failing to match their proportion of the general population. Cultural and religious influences often lead to females being regarded as inferior to males. Family planning is limited, and in the absence of social security and reasonable incomes, large families are the norm.

10. High population growth

This is a feature of the poorest social groups, and correlates with low life expectancy and gender inequality. In some countries high population growth may exceed the economic capacity of the country to feed itself, leading to a propensity to generate refugees, displaced persons, and terrorists.

11. Vulnerability to transnational terrorism

Terrorism often relates to a combination of one or more of the following: poverty, hunger, poor educational attainment, disconnection from democratic principles, susceptibility to indoctrination by intolerant religious ideologies, criminal activities, and psychiatric disorders. Poor countries are usually unable to defend themselves from terrorists, and groups of terrorists may receive covert support from other countries and agencies. Poor countries may form the battlefield for fighting between different groups of terrorists. Recovery from terrorism and conflicts in general may take several generations, and lead to psychological and physiological after-effects in the survivors and their progeny.
projected changes and options for adaptation as well as mitigation (curbing emissions) detailed in the latest 2015 Fifth Assessment Report of the International Panel on Climate Change (IPCC, www.ipcc.ch/). The immediacy of food security during social instability in the Arab Region forms the backdrop to this article, rather than the longer-term infrastructural and social transformations needed to mitigate and adapt to climate-changing emissions, transformations that demand political stability and sophistication.

### Challenges, Assistance, and Needs

The global population is estimated to be around 7.2 billion at present and there is an 80% probability that it will increase to between 9.6 billion and 12.3 billion in 2100 (Garland et al. 2014), so stabilisation of the population is highly unlikely this century. Moreover, human population reduction is not a quick fix for environmental problems, and even a catastrophic event that killed billions of people would have relatively little effect on the overall impact of humans on the environment.

#### Table 1 (continued)

| 12. Weak public sector  |
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| Low salaries, complex and inefficient bureaucratic processes, poor educational attainment, incompetence, widespread acceptance of corruption through bribery and political interference, and the lack of an investigative free media, account for the justifiable lack of confidence in the public sector. A low regard for human rights, legal processes, and justice undermines societal advancement. There is also poor custodianship of cultural heritage and essential infrastructure. |

| 13. Neighbouring countries  |
|-----------------------------|
| Many poor countries have reliance on and vulnerability to neighbouring countries for access to water, transport and communication networks, foodstuffs, energy, control of environmental issues (e.g. desertification, flooding, biodiversity protection, pollution etc.), and security. Neighbouring countries may (a) create security problems by aiding terrorists and insurgents, (b) provide an uncontrolled source of refugees, (c) invade, (d) steal water or other natural resources, and/or (e) issue mendacious media releases or operate diplomatically to undermine the confidence of donor countries, aid agencies, and investors. The more-developed countries rarely understand the sheer difficulty of managing a poor country facing inter-ethnic conflict, and terrorism and poverty. |

| 14. International agencies, non-government organisations, international media and the United Nations  |
|-----------------------------------------------------------------------------------------------------------------------------|
| Poor countries are monitored by a plethora of international and national bodies, and extensive reports generated, but the necessary actions – political and military – to solve the main issues and problems are rarely carried out. Unwarranted aggression inflicted on other countries – poor or not, or the suppression of their populations or specific parts of their populations by nation states eventually must be counteracted by military intervention. Sadly, poor nations are oftentimes regarded as pawns in international power struggles, and remain either exploited for their resources, or ignored. Moreover, economic downturns in donor countries reduce the level of aid and absorption of refugees, made worse by certain countries cynically failing to meet their initially well-publicised aid pledges. |
(Bardshaw and Brook 2014). Population increases could undermine attempts to ameliorate attempts to reduce climate-modifying emissions.

Climate-change predictions for the Arab Region are deeply concerning. Most scientists support the conclusions of the latest Fifth Assessment Report of the IPCC. Formed in 1998 by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO), and relating closely to the UN Framework Convention on Climate Change – the main multilateral forum for addressing climate change, AR5 comprises three Working Group Reports and a Synthesis Report with its Summary for Policymakers. The main issues are covered in detail: observed changes and their causes; future climate changes and their risks and impacts; future pathways for adaptation, mitigation and sustainable development; and a more detailed analysis of adaptation and mitigation including policy options, technology and finance. In the Arab Human Development report authored by Balgis Osman Elasha, (2010), the impacts of climate-change projections in the Arab Region are given in stark detail. In the coming decades, Arab societies and their industries will be profoundly and adversely affected by projected temperature increases in excess of 4 °C and severely reduced rainfall, threats of increasing frequencies of impacts originating from El Nino events, changes in the seasonal distribution and predictability of rainfall, depleted aquifers, reduced river flows, rising sea levels, flash floods, in addition to increased numbers of dust storms and hurricanes. As the Arab Region itself is a relatively small direct contributor to global greenhouse-gas emissions, although its fossil-fuel exports and its importation of goods that took energy to create are substantial contributors to them, adaptation must be a crucial factor in policy developments in more settled times that will themselves be dependent on stable and peaceful Arab countries.

Questions arise as to whether organisations such as those overseen by the United Nations, multilateral groups such as the European Union, individual nations and several charities will be capable of initiating and then maintaining peaceful conditions and food security. Food and other forms of aid are likely to face increasing demands at a time when the economies of many donor countries are enduring continuing austerity and recessionary conditions, and when there is growing but unjustified cynicism about the effectiveness of these aid organisations. Irrespective of the many estimates that total global food production can readily meet the needs of the present global population, political reality is that all countries and people are patently not equal and are unlikely to be so for the foreseeable future. Aid can assist in partially rebalancing the inequalities, not least where several countries in the Arab Region are currently in turmoil and others are deeply troubled. Some regard most of the Arab world as regressing, out of synchrony with, and lacking sympathy from, the world at large. Food costs and poverty are primary concerns, exacerbated by insecurity of energy and water supplies as well as rampaging insurgents and those wishing to impose unacceptable regimes and suppression of minorities, denying their citizens proper democratic freedoms.

Wars and conflicts are all too easily incited in the absence of strong democratic civil society involvement and usually quickly bankrupt countries; destroy nearly all parts of their economies; ruin infrastructure including homes, businesses, transport
and communication networks; disrupt family life and social interactions; generate displaced people and refugees; and attract foreign interference, including active participants. War crimes are commonplace. Psychological aftereffects are noted in civilians and combatants long after fighting has died down. Populations in the Arab Middle East have endured asymmetric warfare between countries with vastly different military capabilities, provoking guerrilla tactics, chemical warfare, civil war, and even unconventional warfare through acquiescence, capitulation, and clandestine support for long-term insurgencies. Wherever they occur, warfare and conflicts are always associated with the participants having distorted views of history – some drawing on ancient history – with widely diverse concepts of ethics, and complicated by ethnic and profound religious differences. Little consensus exists on triggering factors, theories, and outcomes. Prodigious sums of money have been expended in the Arab Middle East on armaments and defence forces to the exclusion of adequate investments in social welfare, education, and research and development.

Political instability for whatever reason usually leads to food insecurity and conflict. During social disturbances and the onset of widespread conflict, the normal mechanisms underpinning food production, importation, storage, processing, transport and retailing are profoundly disrupted, creating conditions that promote the formation of ghettos, and further stimulate corruption, robbery, and the black market. Normal policing and social order collapse, social behaviour degrades, and criminal activities dominate. As the economy collapses, the terms of trade are transformed. Disease epidemics become manifest. The restoration of domestic and business normality takes years and may never be achieved within one or more generations.

Food insecurity itself may lead to political instability, not least in a world of global intercommunications when citizens of a poor country or region can view with understandable envy the lifestyles of those in rich countries or communities. It is therefore a basic duty of political and community leaders to ensure that food security is a foremost priority for those people within their sphere of responsibility. Insecurity of food supplies can be created by adverse weather conditions; the depredations of pests, weeds, and diseases; and salt contamination that can be caused by poor irrigation and agronomic practices. Around 62 million hectares of hitherto fertile land on earth have been damaged by salt. According to *Economics of Salt-induced Land Degradation and Restoration* (Qadir et al. 2014), only tree planting, deep ploughing, and growing salt-tolerant crops coupled to digging drains and dykes around the affected area can address the problem. Neglecting the health of Africa’s soils, many of which suffer almost irreversible degradation and nutrient deficiency, will lock the continent into cycles of food insecurity for generations to come, according to the 2014 Montpellier Panel report. Indeed, 2015 was designated the ‘International Year of Soils’ by the 68th UN General Assembly. Since the 1920s, there are particular issues relating to selection pressures on destructive pests, weeds, and diseases in the vast monocultural single-cultivar agricultural systems that are also the present-day main sources of global food aid. Many of these main producing areas are experiencing irregular rainfall patterns and
failing irrigation arrangements. Crop failures in these areas have quick knock-on
effects on volatility of the global agricultural commodity markets; this is a situation
likely to get worse as the population inexorably increases and demands more food.
Moreover, the world has yet to experience the sort of dramatic harvest failures that
occurred in the 1930s and before. Another aspect of the agriculture sector (gener-
ally accepted to include crops, livestock, fishing, and forestry) in the developing
world is that it absorbs \textit{circa} 22\% of the economic impacts caused by medium- and
large-scale natural hazards and disasters. Between 2003 and 2013, these events in
developing countries affected more than 1.9 billion people and caused more than
$494$ billion, but agriculture only received about 3.4\% of all humanitarian aid
(FAO, 2015, www.fao.org/emergencies/how-we-work/resilience/en/). Delegates
from FAO at the conference announced the launch of a facility that will focus on
bringing together technical expertise and financial resources with the aim of
building greater resilience of agriculture to natural extreme weather events.

The combination of advanced crop and livestock breeding, agrochemicals,
automation, better agronomy and livestock husbandry, increases in the land area
farmed, and efficient larger-scale better-capitalised production units have collect-
ively prevented Malthusian disasters. Since 1950, food production has more than
quadrupled, using less than 1\% more cultivated land, allowing civilisation to
proceed and expand. Food security is no longer an issue in many countries, and
the global economy, human health, and societal development have been, for the
most part, positively influenced by agricultural advancement. In the period
1900–2010, when the global population increased from around 1.5 billion to around
7 billion, average agricultural commodity prices decreased by an average of 0.9\%
p.a. because supplies rose faster than demand (unpublished presentation by Prof.
Ingo Pies in 2014 to biennial development meeting of Pottinger). Nonetheless,
feeding any substantial increases in the global population will only be possible by
technological innovations because of the ecological limitations on increased water
and fertilizer supplies and increasing the area farmed. Likewise, various climate-
change predictions amplify justifiable concerns about global agricultural produc-
tivity. Supply and demand market dynamics are complex and ultimately resilient to
political interference, although many countries and trading blocs try to manipulate
production by tariffs, export bans, subsidies, inhibiting technological developments
and market processes. The spikes in prices of traded wheat, rice, maize, and soya in
2008 and 2011 were initially blamed on speculation, especially the index tracking
funds and derivatives markets. Yet this type of speculation does not trade physical
goods but price risks, and is therefore a form of insurance market. In addition,
speculation would be expected to be associated with high stocks as farmers opt for
storage rather than sales. In 2008 and 2011, however, stocks were very low and
cauld the price rises. Even so, government policy failures, including protectionist
export bans and inadequate promotion of agricultural efficiency, contributed to
panic buying, as exporters reduced their offer and importers increased their demand
in response. Calls by civil society groups to ban speculation by index-tracking funds
and derivatives markets were always and continue to be profoundly misguided. All
countries should have policies to sustain and constantly review food production and
supply, especially if there is a significant dependence on food imports. Reasonably substantial reserve food stocks are essential cushions to prevent price bubbles and food shortages, but excessive stocks can distort markets such as when they are released in large quantities as general food aid and undermine the operation of normal agriculture markets in developing countries. Some price volatility is an essential component of healthy competitive markets, driving adaptation, risk taking and innovation.

Debates about the environmental costs of different kinds of agriculture, not least in terms of water and energy security in respect of the Arab Middle East, and in terms of the destruction of natural habitats and loss of biodiversity, as well as cultural and other changes, have stimulated possible strategies to address these concerns. One approach is for each country to have a “roadmap” for its agricultural development, and these roadmaps might be aggregated into a regional roadmap. The US report: *A Science Roadmap for Agriculture* – cited as *Task Force on Building a Science Roadmap for Agriculture*, National Association of State Universities and Land-Grant Colleges, Experiment Station Committee on Organisation and Policy, “A Science Roadmap for the Future”, November 2001 (www.nasulgc.org/comm_food.htm) http://agsci.oregonstate.edu/files/main/roadmap2.pdf pioneered a way to define the needs of agriculture and help shape the future direction of the various strands of agriculturally relevant science. This impressive US-specific study followed a conceptual framework of needs to (a) be competitive in a global economy; (b) add value in future harvests; (c) adjust agriculture to a changing climate; (d) be good stewards of the natural environment and natural resources; (e) make agricultural enterprises profitable; (f) make families and communities strong; and (g) modify foods for improved health and safety. One important relevant outcome of this work is the obvious requirement to grow crops and practice livestock husbandry in the most appropriate environments, enabling different environmental zones to have a critical mass of expertise and facilities. For the water-constrained Arab Middle East, this would mean increased reliance on food imports that could also be regarded as a form of water importation. But this would be possible only if there were formal agreements between food-producing and food-recipient countries, and these agreements were economically and politically stress-resistant. To this caveat would be questions of how to pay for imports, and acquiring resources required to redirect the agricultural workforce into other wealth-creating activities. Introduction of a logical, science-led agricultural roadmap in the Region may be impossible at present but needs to be initiated. On a global level, food commodity and non-food agricultural commodities prices have declined by 17–18% in the period mid-September 2014 to mid-September 2015 (see *The Economist* Commodity–Price Index (2015) in www.Economist.com/indicators), reflecting relatively clement weather conditions in most of the producing areas, greater production efficiency, balance sheets strong enough to bear losses, competition to gain market share, and continuing investments. Importing countries, however, are affected by the strength of their currencies amongst other factors, such as social upheaval. Unlike other commodities whose prices reflect industrial demand, prices of foodstuffs reflect the effects of weather, pests and diseases, the demands of a rising global population, and many kinds cannot be readily
stockpiled. A further factor operating at the global level is the domination of farm supplies by six international companies: Monsanto (the largest seed producer), Syngenta (the largest agrochemical producer), Bayer, BASF, Dow Chemical, and Du Pont). All of these companies have been active in acquiring other companies and patents, thus reducing competition, and potentially reducing innovation as they robustly defend their intellectual property. In this era of low commodity prices and developing resistance to older-type herbicides, farmers are constrained by input costs of fertilisers, seeds, agrochemicals and veterinary medicines that have steadily risen in over the past decade, only partially alleviated by the recent reduction in fuel and lubricant costs.

Pandemics – epidemics of infectious or contagious disease that have spread through populations across a large region, crossing international boundaries – drastically curtail food production and distribution, aggravating poverty in both the rural and urban poor. Pandemic-causing diseases include the ever-present cholera, influenza such as the 1918 and 2009 H1N1 outbreaks, typhus, smallpox, measles, tuberculosis, plague (*Yersinia pestis*), leprosy, malaria, human immunodeficiency virus infection and acquired immune deficiency syndrome (HIV/AIDS), viral haemorrhagic fevers (ebola, Marburg, Crimean-Congo, Lassa, Rift Valley, dengue, yellow fever, etc.), and now there are new diseases such as severe acute respiratory syndrome (SARS). Vaccine development is necessarily slow, and treatment of bacterial diseases is hampered by the rapid development of antibiotic resistance. The propensity of diseases to mutate, acquire new vectoring capabilities, have reservoirs in wild animals, and even persist in spore form, mean that there must be constant vigilance.

As one of the major global food-producing bloc of nations, and as one of the major food importers and donors of food and other forms of humanitarian aid, the European Union (EU) bears crucial responsibility for the deleterious effects of its complex and highly bureaucratic common agricultural policy. Its massive subsidy regimes impact adversely on global markets and its well-meaning but often poorly thought-through environmental regulatory decisions are not based on sound scientific evidence. So-called “greening” policies are being introduced that may be deemed to enhance the environment but are likely to decrease profitable production. Social measures to support small-scale inefficient producers also distort the global marketplace. Likewise, the series of restrictions being introduced on the use of a wide range of agrochemicals within the EU and for imported commodities, without carrying out proper impact assessments and fast-tracking alternatives, imperil production. In the medium to long term, a more serious issue is the virtual ban in genetically modified (GM) crops, inhibiting their uptake in countries intending to export to the EU as well as suppressing state-of-the-art research and development and associated investments in EU countries. Of particular relevance in this regard is the recent and largest statistically rigorous review of the agronomic and economic effects of the current range of commercially available GM crops on farming (Klümper and Qaim 2014). In examining publications between 1995 and March 2014, it is therefore a near-complete survey. In essence, the two main types of GM crop – resistance to insect pests and tolerance to the wide-spectrum weedkiller...
glyphosate – conferred considerable yield improvements and much higher profits than conventional crops. GM crops and related products in the development pipeline were not considered, and these promise great advances in nutrition enhancement, environmental clean-up, new medicines, new products for manufacturing industries, and improved crop and forest species. Moreover, existing GM crops have greater impacts in poorer countries than in richer countries because their insect pests and pernicious weeds are more difficult to control. By including non-peer-reviewed papers (book chapters, working papers, conference papers etc.) as well as peer-reviewed papers for the meta-analysis, it was possible both to correct for academic bias in focusing just on the most dramatic effects, and include data for many ancillary effects, such as the effects of fertilisers. The EU ban on GM crops is therefore denying poor exporting countries from reaping the full benefits in yield, profitability, and commodity quality, in addition to reducing potential EU food-aid exports. One positive feature of the EU is the bureaucratic system to improve and monitor the quality and safety of foodstuffs, from raw ingredients through to ready-meals, and GM crops have been found to be safe. That for many years most of the feed protein in the EU comprises imported GM maize and soya bean, the issue of GM crops should not be ignored for much longer. Opposition to the processes of modern genetic modification and ownership of the processes (often deeming them to be “unnatural”), and disregarding the quality, safety, and value-for-money of the product, actually condemns conventional agricultural practice, and demonstrates ignorance of naturally occurring mutations and horizontal gene transfer. Even so, in early November 2014, the newly elected President of the European Commission, J-P Juncker, in what is widely regarded as a blatant act of appeasement to Greenpeace and other so-called “environment” pressure groups, sacked the EU’s chief scientific advisor, Professor Anne Glover, for her support of GM technology, compounding this regressive stance with abolition of the post. All countries and trading blocs should have influential and competent teams of chief scientific advisors.

Research and development in gene identification, construction, insertion, editing, and expression, coupled to high-throughput phenotyping are collectively revolutionising agricultural, horticultural, and forestry sciences. GM technology is not simply the insertion of genes using various technologies from a similar or different species into a recipient organism. It includes the concept of gene silencing – the prevention the reduction of expression of certain genes – a process that can take place at either the transcription or translation cellular processes. It is not the equivalent of gene knockout but is essentially gene knockdown because the methods to silence genes do not completely eliminate the expression of a specified gene. The methods to silence genes include RNA interference (RNAi or post-transcriptional gene silencing), small interfering double-stranded RNA (siRNA), and CRISPR. Of special interest is the CRISPR (clustered, regularly interspaced, short palindromic repeats) toolkit that is derived from research on prokaryotic antiviral systems and currently involving the Cas9 and Cpr1 endonucleases (Jinek et al. 2012; Cong et al. 2013; Bolukbasi et al. 2015). As viruses constantly evolve to escape from these antiviral systems, bacteria probably evolve new systems.
CRISPR technology is able to recruit heterologous domains that can regulate endogenous gene expression as well as label specific genomic loci in cells, so that is feasible to engineer germ lines and thus the path of evolution. This technique is replacing methods using mutagenic agents, virus vectors, zinc-finger nucleases and transcription activator-like effector nucleases (TALENs). Its relative simplicity and evolutionary significance for all life forms, including humans, means that internationally agreed regulatory frameworks are essential. The technology does not involve implanting genes from one organism into another, and is not therefore creating transgenic organisms; it is gene editing.

There is now realistic expectation of new perennial cereals; incorporation of C-4 photosynthetic characteristics in existing C-3 crops; enhancement of nitrogen fixation by free-living soil microorganisms in the vicinity of crop roots; tolerance and resistance to biotic and abiotic stresses; and modification of lignification, texture and endogenous components (such as vitamin content, acrylamide in potatoes, antinutritions, toxins, proteins, oils, and carbohydrates) of a wide range of existing and potential crop species (see www.isaaa.org/kc/cropbiotechupdate). Besides the present-day generation of improved livestock species and new forms of husbandry, the use of balanced diets based on competitively priced synthetic amino-acid and fatty-acid products will lessen the need for large-scale soya and maize production. Ancillary advances are taking place in mechanisation; diagnostics; predictive modelling and decision-support systems; remote sensing; protected-cropping systems; and weed, pest, and disease control. Diminution of abiotic and biotic stresses in the field and under protective cropping is now the focus of major research initiatives.

Of the circa 250,000 species of angiosperms, according to the Food and Agriculture Organisation of the United Nations (FAO 2004), only 30 species provide 95% of human energy needs and only four species (rice, wheat, maize, and potato) account for 60% of energy intake, and 75% of crop diversity was lost in the last century. Around 80% of human calorie intake comes from 12 crop species (Grivetti and Ogle 2000) and 50% comes from just three grasses – wheat, maize and rice (see www.knowledgebank.irri.org/ericeproduction/importanceofRice.htm) dependency on such a narrow genetic base is a threat to food security and is only partially alleviated by investments in in situ and ex situ plant gene/seed banks, germplasm collections, and DNA libraries. Just 7000 species of angiosperms and gymnosperms have been cultivated for human consumption in human history, with around 80,000 angiosperm species yet to be discovered. In theory, most angiosperms should be capable of being biotechnologically modified for food and non-food uses. Will scientists in the Arab Middle East fully participate in these exciting developments? Valuable collections in the Arab Region are inadequately respected for their worth under peaceful conditions but are now extremely vulnerable during this period of war-like conditions and enduring financial pressures.

Coming into force in 2004, the International Treaty on Plant Genetic Resources for Food and Agriculture (International Seed Treaty) was designed to complement the 1993 Convention on Biological Diversity (CBD) and was designed to guarantee food security by (a) conservation, exchange, and sustainable use of all types of plant
genetic resources; (b) offering fair and equitable benefit-sharing; and (c) recognition of farmers’ rights. Critics of the International Seed Treaty point to great variability across countries of access to collections and interpretation and implementation of farmers’ rights. Moreover, in adopting the CBD’s outlawing of biopiracy – the uncompensated commercialisation and profiteering of seeds, propagules, growing plants, and their products from source areas – has severely inhibited the acquisition and exchange arrangements in collections until better processes come into force.

Gap analyses are methods to identify gaps in *ex situ* collections of wild-plant relatives of agriculturally relevant species as a means to guide efficient and effective collection strategies (Villegas et al. 2010). A gap analysis by the International Center for Tropical Agriculture managed by the Global Crop Diversity Trust and the Millennium Seed Bank in Kew examined 29 priority gene pools of the globally most important food crops and their wild relatives. Most at risk were eggplant, potato, apple, sunflower, carrot, sorghum, and finger millet (see [www.cwrdiversity.org/conservation-gaps/](http://www.cwrdiversity.org/conservation-gaps/)). Ongoing conflicts and disorder in the Arab Region justify an independent review of a regional Red List Index based on the List of Threatened Species released by the International Union for the Conservation of Nature ([www.iucn.org](http://www.iucn.org)) in order to evaluate the extinction risk of species and subspecies of the natural flora and fauna.

Certain individual countries in the EU are important donors of humanitarian aid in their own right. According to a recent report (November 6, 2014) from the Organisation for Economic Co-operation and Development, economic stagnation especially in the Eurozone portion of the EU poses a major risk to world growth. If the stagnation were to continue or even get worse, humanitarian assistance would inevitably be reduced, and countries that hitherto were willing donors would become increasingly introverted. As evidenced by growing problems of graft, corruption and authoritarian government in certain (but not all) members of the EU that were formerly dictatorships or in the sphere of influence of the former Soviet Union, democratic norms (human rights, respect for minorities, tolerance, free press, independent judiciary and rule of law, active civil-society groups, transparency of accounting for taxpayers’ money etc.) take time to become bedded into the fabric of society. In considering the medium-to-long-term future of the EU, it is sobering to note that throughout European history, confederations between its diverse nations and subsets have rarely persisted unless full political, legal, monetary, and more profoundly, cultural fusion had taken place.

All governments worthy of the title must ensure that there are relief mechanisms to enable the provision of basic food supplies and fresh water together with functioning standby electricity-generating equipment in unsettled times caused by natural or man-made disasters. Surely governments have the ultimate responsibility to attend to the needs of their people and not themselves. Rarely observed, governments need genuine food, nutrition and agricultural experts as an integral part of the decision-making hierarchy. Such experts must have a proper understanding of the pre-conflict or pre-disaster food, fresh-water, and energy supplies and their distribution systems, and how they can be safeguarded, modified and employed to proper
effect, and how alternative mechanisms can be deployed. Sadly, this aspect seems to be neglected at the present time in the chaotic condition of certain countries in the Middle East. Much can be learned from countries in Europe during the wars that raged in the nineteenth and twentieth centuries. Simply standing by and watching the population adapt slowly to acquiring barely adequate water and food supplies inflicts untold misery on innocent people. All governments should have readily accessible emergency supplies (reserve stocks) and transport systems, and be willing to introduce rationing if need be. Special protection measures are needed for water supplies and farms to make sure production can continue no matter the degree of impairment. In more settled times, each government should establish a group of experts to construct interactive databases as the foundation of an agri-informatics and metrics organisation. This would collate information on supply and demand changes, supply-chain details, imports, crop and livestock genetics, commodity production levels, labour-force composition, pricing, inputs, availability of decision-support systems, advisors and research bodies, grant funding, biotic and abiotic stress factors, natural resource constraints, predictive modelling of shocks to the agricultural system and disruptive events, etc. Other research organisations would interact with this organisation to ensure best practice and enhance agricultural resilience, demonstrate efficient use of inputs, exploit wastes, optimise the use of mechanisation, and foster skills. Arab countries still have to utilise fully the international capabilities and potential of (International Centre for Agricultural Research in the Dry Areas – currently based in Beirut given the conflicts in Syria) and other members of the CGIAR consortium (formerly the Consultative Group on International Agricultural Research).

The plethora of aid agencies offering humanitarian and development aid encompass those that are organised by a single government, multilateral donors, non-governmental organisations, philanthropic and charitable organisations, businesses, and individuals. ReliefWeb (www.reliefweb.int) provides a relatively comprehensive Directory of Humanitarian Organisations. Fragmentation of the total aid effort is becoming a worrisome issue. The International Committee of the Red Cross, part of the International Red Cross and Red Crescent Movement along with International Federation of Red Cross and Red Crescent Societies and 189 National Societies, is mandated internationally to uphold the four treaties and three additional protocols of the Geneva Conventions. These Conventions are rules that apply in times of armed conflict both within and between countries, and define the rights of civil and military prisoners and protections for wounded people and for civilians. Weapons of war are dealt with by The Hague Conventions and the biochemical warfare Geneva Protocol. Enforcement of the Conventions is through the UN Security Council but is rarely invoked, primarily because of profound ideological differences about democracy and human rights between the five permanent members of the Security Council with veto powers, so there tends to be diplomatic reliance on regional treaties and national laws. Parenthetically, there are ten non-permanent members of the Security Council without veto powers that are elected by the General Assembly of the United Nations for a two-year period. On 19 November 2014, the UN Security Council pledged to counter the global terrorist
threat and increase cooperation to address the perils posed by foreign terrorist fighters such as those that are a notable feature of conflicts in the Arab Region. The UN Office on Drugs and Crime is also involved in this initiative. Other international related treaties include the United Nations multilateral treaty referred to as the Geneva Protocol or Convention relating to the Status of Refugees as well as the Declaration on the Protection of Women and Children in Emergency and Armed Conflict adopted by the United Nations in 1979.

Humanitarian aid is distinguished from humanitarian intervention, which involves armed forces protecting civilians from violence or genocide. The United Nations Office for the Coordination of Humanitarian Affairs is mandated to coordinate humanitarian responses, usually in concert with the International Committee of the Red Cross. Valuable reference material can be found in (a) the postings from the Global Policy Group; (b) Humanitarian Policy Group Policy Note 34 Providing Aid in Insecure Environments; (c) the global resource for non-governmental organisations People in Aid Code of Good Practice, which is an internationally recognised management tool; (d) postings of the Humanitarian Accountability Partnership International, notably the HAP 2007 Standard on Humanitarian Accountability and Quality Management; and (e) the Food Assistance Convention Treaty that entered force in January 2013 and is aimed at meeting the food and nutritional needs of the most vulnerable people, complementing the Food Aid Convention which unlike the Assistance Convention is focused on a limited number of food items expressed as ‘wheat equivalent tons’. Both have their legal depository in the Secretary General of the United Nations. Three other sources of crucial information are (a) the FAO 2014 (b) Food and Nutritional Needs in Emergencies (www.who.int/nutrition/publication/en/nut_needs_emergencies_text.pdf), consisting of guidelines to estimate and monitor food and nutritional needs of populations in emergencies, developed jointly by the United Nations High Commissioner for Refugees (UNHCR), UNICEF, World Food Programme, and World Health Organisation; and (c) publications of the International Food Policy Research Institute (IFPRI), especially Global Nutrition Report 2014, Resilience for Food and Nutrition Security (2014), and How to Build Resilience to Conflict: The Role of Food Security 2014. According to the World Bank, IFPRI, and FAO, the number of undernourished people in the world, based on calorific intake, now stands at about 805 million, despite real global growth rates of 3.6% over the period 1990–2014. This figure increases to circa two billion suffering from micronutrient (minerals, vitamins etc.) deficiency. According to the IFPRI 2014 Global Hunger Index by Grebner et al. (2014), the state of hunger in developing countries as a group has improved by 39% since 1990. Even so, the level of hunger is still serious with an estimate of 805 million people continuing to go hungry. The highest levels are south of the Sahara and south Asia.

In the IFPRI Global Nutrition Report 2014, evidence is summarised to show that improvements in nutrition status will make large contributions to sustainable development goals, namely poverty, food, health, education, gender, and employment Investment in nutrition has a highest benefit ratio. Projections from the World health organization (WHO) and UNICEF demonstrate that the world is not on track
to meet any of the six World Health Assembly (WHA) nutrition targets (reducing child stunting, reducing anaemia in women of reproductive age, reducing low birth weight, reducing the number of overweight children, increasing exclusive breastfeeding, and reducing child wasting), although many countries are making good progress in meeting nutrition outcomes. The manifestation of malnutrition is changing as countries are now facing complex, overlapping, and connected malnutrition burdens. Three of the chapters in the IFPRI publication Resilience for Food and Nutrition Security (Fan et al. 2014) are germane to this article. Breisinger et al. (2014) briefly mention the Arab Spring and uses Egypt, Somalia, Sudan, and Yemen as case studies of conflict-affected countries. Mabiso et al. (2014) have specific reference to the Syrian refugee crisis, and take a global overview of the complex relationships between refugees and host countries. Babu and Blom (2014) introduce a model that seeks to delineate the key capacity components of a resilient food system, considering a country’s capacity to create, manage, and utilise human resources for a resilient food system.

Significant challenges to aid provision include (a) harnessing the necessary stream of funding when grandstanding promises by countries are often never met; (b) establishing and coordinating the basic support network; (c) ensuring the logistics arrangements are effective, including communication networks; (d) prevention of resource misappropriation; (e) protection for officials and support workers on the ground; (f) protecting the vulnerable people needing aid; (g) operating with transparency and integrity; and (h) laying the structural and procedural foundations for self-reliance.

Effective lines of communication with donors and international agencies and charities are pivotal so that emergency arrangements can be established without delay and hindrance. These bodies need to deal with those individuals in the recipient countries truly knowledgeable about the capacity and specific problems facing food and water security, and fast-moving internal developments. The experts in the recipient countries must have the authority to be able to (a) quantify the levels of demand, (b) direct supplies, (c) recommend the siting of depots and distribution centres, and (d) highlight points of accessibility and vulnerability. In poorly governed countries, experts must be prepared to deal directly with these donors, agencies, and charities, difficult as that might be. The complexities of globalisation extend beyond food and water security (Lerche 1998).

When people are deliberately persecuted, and honest law enforcement collapses, then non-partisan protection must be afforded, usually with outside security forces. Unfortunately, ideological differences mean that the international community has often been shown to be ineffective in bringing about rapid termination of conflicts by imposing observers or armed forces, although thanks to relatively few major international donors, humanitarian relief has been forthcoming, albeit frequently late and inadequately funded. Dealing with refugees and displaced people requires expertise and sympathetic support. Housing provision together with monitoring and combating infectious diseases, usually run in parallel with the issuance of food supplies. Governments that prepare for worst-case scenarios are to be commended. Even the distribution of authoritative guidance for populations in stress would represent a small step in the right direction, as would reinforcing the institutions
that bind civil society, such as voluntary rescue and care organisations. Networks of low-temperature clean and secure depots with associated distribution centres should be set up at the outset of disasters and conflicts. Even in peaceful times, a marked cut in food waste helps food security. According to M. M. Rutten (Rutten 2013) around a third of the food for humans produced annually (about 1.3 billion tonnes) is either lost or wasted, and in developing economies the situation tends to be worse, with in excess of 40% lost during harvesting, processing and storage (FAO. 2011. Global food losses and food waste – Extent, causes and prevention (See www.go.nature.com/um7vga).

Basic needs of refugees, as recommended by the UNHCR and related organisations, are modest but are directly applicable to those displaced or besieged in their own country. UNHCR recommends each refugee receive more than 2100 calories per day, recognising that a lack of food variety and inadequate supply of fruit and vegetables lead to deficiencies in essential vitamins and minerals. Calorific intake can be reduced if the provided foodstuffs do not conform to traditional diets, or if the rations are traded to acquire other non-food goods and services. Encouragement is needed to set up temporary gardens. Fresh-water provision is of primary importance, with a minimum of 20 litres per person. A greater volume is needed, though, to prevent public-health problems of diarrhoea, cholera, and even polio. Thus, clean-water sources and pumps are required along with taps within walking distance. Vessels are needed for transfer and storage of water. Water-purification tablets should be provided. Sanitation systems are essential for hand washing and the safe disposal of urine, faeces, sanitary towels, wound dressings, infected and contaminated materials, and for the disposal of dead bodies. Monitoring of faecal contamination is recommended. Housing refugees and displaced people at short notice demands special expertise to avoid overcrowding and give adequate protection against inclement conditions. Overlaying the fundamental needs for food, water, and shelter are meeting basic medical needs, particularly of the young, women, and the old and frail. In addition, within a short time, children require to be educated.

Host communities and host countries sometimes resist integration of forcibly deracinated people and can grow resentful at the costs incurred, especially if the host economy is weak. Most financial assistance from donor countries is given to aid agencies rather than host countries. Large-scale influxes of refugees can soon overwhelm the host country’s infrastructural resources (chiefly fresh water, energy, housing, hospitals and healthcare systems, education, and waste disposal). Other problems arise from combatants embedded in refugee cohorts, spreading the conflict and increasing policing costs. Cultural incompatibilities between refugees and the host population create hostilities. Refugees can suffer the dire consequences of being rendered stateless. In general, it is fair to say that humanitarian care is not able to sustain basic needs in the medium to long term. As a consequence of a funding crisis for humanitarian aid in the Arab Middle East, the World Food Programme was forced to suspend its desperately needed food-aid-voucher scheme for more than 1.6 million Syrian refugees at the beginning of December 2014, the onset of winter. This suspension meant that refugees were less welcome in host countries
and border closures are already being implemented in the immediate area as well as in the European Union.

Axiomatically, just as responsible governments must be alert to and prepared for civil and other forms of unrest, they should always promote food production and remove any impediments to the uptake of improved technologies so that their economies have inbuilt resilience to dreadful events. Likewise, governments should have in their ranks, or instantly available for consultation, competent scientists, technologists, and engineers able to advise on food, water, and energy resource distribution and allocation. Over the past few decades, public-sector agricultural research and development in virtually all countries have suffered financial reductions and financial resources have been switched to activities regarded as more exciting and with greater wealth-creating potential; history shows this to be monumentally misguided. The urban disregard for agriculture is likely to continue as urbanisation increases, until the point food security threatens social stability. Active or benign neglect of food-producing, food-processing, and food–distribution industries as well as of the scientists, technologists, and engineers underpinning its productivity, improvement and efficiency reveal incompetent governance. As an aside, the dearth of scientists, technologists, and engineers in active politics accounts for numerous policy failures. Graduates in the arts (such as history and politics) and social sciences dominate politics and the upper echelons of the machinery of government (civil service) worldwide, people with little understanding or appreciation of business let alone of the “hard” sciences and engineering and their essential utility (and limitations) for mankind. Perhaps this explains the growing dissatisfaction with the prevailing political classes. The scientific approach is that of the quest for knowledge by constantly questioning, developing and testing hypotheses by experimentation so that opinions change as “facts” change, often-times undermining policies that are not evidence-based, whereas many political parties are founded on inflexible belief systems, as are almost all religions.

One aspect of food security in times of conflict and community disharmony has been the remarkable resilience of researchers to continue their studies or just maintain libraries, databases, records, laboratories, and genetic resources under the most trying conditions. The pursuit of knowledge is a fundamental feature of humans, as is the search for improvement. When there is blatant disregard of national constitutions as well as United Nations treaties, protocols and conventions, and universities, colleges, schools, and research institutes become targets of malevolent forces, then the rest of the world must have no other option than to intervene, regardless of diplomatic niceties, in order to restore at least the vestiges of societal normality. As a first step, food security and the provision of fresh water for the besieged people must be a priority.

If and when particularly large, heavily populated countries become embroiled in conflicts and/or major natural disasters, the existing international support efforts are likely to fail. This, in turn, may lead to a series of related conflicts, as opposing ideological pressures culminate in outright wars, invasions, and suffering on a huge scale. Throughout the world, history has shown that unless they are relatively rich (and that may not be enough), smaller or militarily weak larger countries are
influenced, for good or ill, by their more powerful and sometimes aggressive neighbours. As recent events demonstrate, conflicts in smaller countries rarely bring about rapid corrective measures from the international community, and adverse and damaging propaganda actively promoted in donor countries can prolong the suffering. Ultimately though, food and fresh-water security are a prerequisite and eventually underpin stability, peaceful and thriving economies.

**Conclusions**

Today, much of the Arab world is poorly governed and insecure for its citizens; they urgently deserve a better life. Many of the most talented Arabs seek a better life elsewhere. The warfare must be ended forthwith. Grossly and unfairly misunderstood by much of the rest of the world, Arabs demonstrate admirable resilience and stoicism yet retain their sense of humour tempered by understandable cynicism and justifiable suspicion of conspiracies. Enemies of the Arabs subject them to a tirade of insults and demeaning innuendos, often designed to deny them basic rights and international support. Nonetheless, Arabs must not be the continuing authors of their own misfortune, and a first step would be an end to internal conflicts followed by an effective Region-wide clampdown on corruption at all levels. Remember – it is the victor who determines the writing and shape of history. If the level of insecurity in the Region were to get worse, then not only the Arabs but also the rest of the world would pay a high price, so it is in everybody’s interest to help restore peace. Bluntly, the solution to their problems lies in the actions of the Arabs themselves.

In fully grasping the opportunities available through top-quality education (Baydoun and Hillman 2012), high standards of integrity and tolerance can be demanded from those in leadership roles in communities, organisations, businesses, and local and national government. Ignorance can be reduced, even if not eliminated. Essential components of democracy can be established, including independent and diverse news media, an autonomous judiciary operating to high standards of justice and unaffected by pressure groups and politicians, freedom of speech, and dynamic humanities and artistic sectors. Wealth, and security of food, water, and energy, can and must be assured through the knowledge economy. Harmony can be restored to communities suffering deep-seated divisions. Furthermore, countries in the Arab Middle East will then be in a position to interact much more effectively and comprehensively in the international arena so that, if needed, external support and assistance can be fully and timeously harnessed. Despite all the odds, this transition must be accelerated from the current dangerous condition to a much more enlightened and prosperous existence. Education throughout society has proved to be a slow process, and can be resisted by regressive forces and indolence, so responsible leadership is a prerequisite. Arab scientists, technologists, and engineers must contribute actively to this transition, thereby securing a safe, healthy, and buoyant future for all Arabs. Research and development priorities must be
reassessed in the light of worsening nexus of water, food, and energy insecurity, and
the desperate need to return to peaceful conditions. In legal jargon: time is of the
essence. Finally, a buoyant growth potential for the Arab Middle East is dependent
on the fundamentals of demography, education, access to capital, technology,
careful custodianship of its natural resources and environment, and social stability;
all are threatened by this insecurity nexus.

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