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# Food Security with Equity through Social and Technological Innovations

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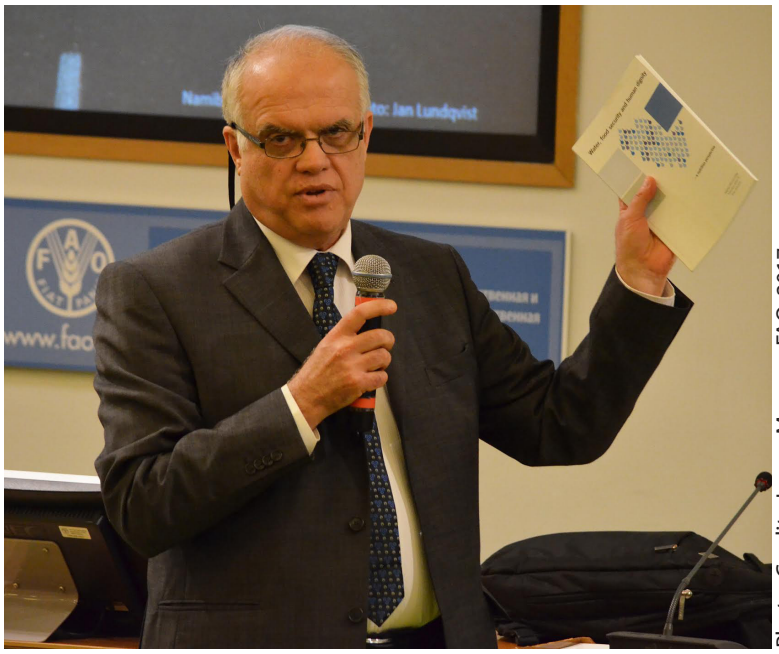
# Editorial

## Food security with equity through social and technological innovations



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**Dr. Olcay Ünver** is the Deputy Director, Land and Water Division, Food and Agriculture Organization of the United Nations (FAO), Rome, Italy. He is a member of the Editorial Board of the Future of Food: Journal on Food, Agriculture and Society.

This issue of Future of Food Journal comes at a time when the trends in the drivers of food and water, and the state of the natural resource base are giving unfavorable signals. Chronic hunger is on the rise following a steady decline of a decade; adult obesity is increasing in all regions irrespective of level of economic development; and childhood obesity is increasing in most regions. The prevalence and number of deaths due to overweight and obesity are now greater than those due to underweight and hunger. One third of land on a global scale has been lost to erosion and pollution over the past four decades; and half of the world's topsoil has been lost in the past 150 years. Major decreases in the insect biomass around the world further add to the concerns, among others, for the future of agricultural production. Against this background, we must meet the needs of a projected global population of approximately 10 billion people, who will demand 50% more food and another 50% more water than those in 2012. The gap between supply and demand could be as high as 40% by 2030. Yet, one third of all food produced globally is lost or wasted, and water-use efficiencies remain far below attainable levels.

There is widespread recognition, however, of these challenges and constraints, and we see them addressed in the major global policy discourses (e.g. 2030 Sustainable Development Agenda and Nationally Determined Contributions to the UNFCCC), National Development plans and programs, and by the private sector. The implementation aspects, including funds and funding schemes, governance arrangements, and the role of science, technology and innovation are now more prominent agenda items at all levels, with promising developments being reported frequently. One such development is the steady increase in funding for agricultural research and development, which rose by 3.1% per

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year in the first decade in the 21st Century after a slowing trend in the late 1990s. It is important to note that the R&D spending also grew in low-income countries, albeit at a slower rate.

The business as usual approach, with patchwork, detached measures, will not yield the desired outcomes. Major changes must be put into effect quickly and decisively. Achieving food security should take into account the three dimensions of sustainability (plus governance) and impacts of climate change. Public policy should ensure that food security and nutrition (FSN), poverty eradication and sound natural resources management go hand in hand. This approach should cover all aspects of the food value chain, from production to post-harvest management, storage, transport, and processing, and from marketing to consumption, with both supply and demand dimensions incorporated into policies and interventions.

## Innovation for food security and nutrition for all: Prospects and examples

The broad context within which FSN should be considered is built on three pillars: economic development, including eliminating hunger and poverty, and access to basic services for all; healthy and functioning ecosystems; and resilient livelihoods. Regarding these pillars, I would like to offer examples and prospects of innovation linked to the four main dimensions of food security: availability, access, utilization, and stability (FAO, 2008).

### *Food Availability*

Innovation opportunities related to the availability of food include those to increase agricultural productivity as well as land and water productivity through improved plant varieties (e.g. crops resistant to disease, pests, heat, or droughts; salt-tolerant crops; transgenic crops), interventions for higher crop yields (e.g. low-cost toolkits for extension workers, marker-assisted breeding, etc.), increasing soil health and organic carbon in soil, interventions to enhance water availability (e.g. rainwater harvesting, groundwater detection sensors, low cost water storage, wastewater reuse) and proper irrigation and fertigation technologies, coupled with irrigation scheduling and adaptive management. In the livestock sector, innovations in efficient animal production, animal nutrition (e.g. high-nutrient, low cost fodder), feeding practices, animal diseases and management (e.g. low-cost veterinary toolkits and pharmaceuticals), along with practices to reduce greenhouse gas emission intensity and environmental impacts are to be envisaged. In aquaculture, innovations in reproduction, disease management, holding systems and feed technologies are some of the opportunities. Urban and peri-urban farming present innovation opportunities, too, such as indoor and vertical farming, aquaponics, and low-cost greenhouses.

### *Food Accessibility*

Improving access to food has perhaps the most significant potential among all as 1.3 billion tons of food is lost or wasted every year. Saving one quarter of that amount would be enough to feed the 815 million people suffering from chronic hunger. Much potential exists in improving access of smallholder farmers to markets, and appropriate post-harvest technologies, including adequate and proper storage of the products and handling, refrigeration and transport. Some of the possibilities are fruit preservation, milk chilling, seed and grain drying, rice parboiling and drying, low cost refrigeration and vacuum/hermetic sealing.

### *Food Utilization*

Nutrition innovations to tackle malnutrition, both underweight and obesity, can help address inadequate intake of nutrients, which is often coupled with an intake of excessive calories. Biofortification (i.e. incorporation of critical nutrients and vitamins, especially into staple crops) can be listed under this category. The HarvestPlus Program, hosted by the International Food Policy Research Institute, has pioneered biofortification as a global plant-breeding strategy for a variety of crops such as vitamin A-enriched cassava, maize and orange-fleshed sweet potatoes, and iron and zinc-fortified rice, beans, wheat and pearl millet in over 40 countries (https://www.ifpri.org/program/harvestplus ).

### *Food Stability*

The increased uncertainties as a result of climate change make a wide spectrum of food systems vulnerable to the otherwise manageable drivers. The broad response to this is climate-smart agriculture,


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which incorporates climate science in transforming and reorienting agriculture in support of food and nutrition security through sustainable increases in production and productivity; adapting and building resilience to climate change; and reducing greenhouse gas emissions to the extent possible. Much potential lies in this area for innovative solutions. Use of big data and internet of things (IoT) offer some of the current and promising innovations that can enhance food stability. FAO's updated Climate Smart Agriculture Sourcebook (http://www.fao.org/climate-smart-agriculture-sourcebook/en/), released in Bonn, Germany during COP23 of the UNFCCC, lists a broad and diverse number of examples and possibilities for crops, livestock, aquaculture/fisheries, and forestry.

## Three areas to watch for innovation

Much potential exists in agricultural biotechnology to enhance production, productivity and sustainability in agriculture. The possibilities range from low-cost, low-technology solutions to high-end technology, including advanced DNA-based methods, genetically modified organisms (GMOs) and nuclear techniques in food and agriculture. The polarizing debate GMOs have stirred since the 1990s casts an unfortunate shadow on the use of other biotechnologies, and their potential for products, such as new crop varieties, which could benefit smallholders and those sectors where the private sector has little or no commercial interest.

A second area to watch is the use of information and communications technologies (ICT), which enable agricultural innovation by providing a wide range of information, from weather to market conditions, and allowing connectivity to buyers and customers as well as between producers, for example. More recently, ICT has created the possibility for those who have difficulty accessing formal financial services and infrastructure to make financial transactions. ICT can also help strengthen the links from science to extension and technology transfer, as well as broaden the use of the non-proprietary genetic material.

The third area to watch is the innovations to deal with water scarcity, including not only the physical scarcity of water but the scarcity emanating from lack of infrastructure, investments or capacities, all with consequences for or links to FSN. This results in alternative pathways to food and nutrition related targets, depending on the policies (or lack of them) chosen to cope with water scarcity (Lundqvist & Unver, 2017). A recent multi-stakeholder initiative, Global Framework on Water Scarcity in Agriculture in a Changing Climate (WASAG), established by FAO and its partners (http://www.fao.org/land-water/overview/wasag/en/) brings together actors from governments and the public sector, United Nations agencies, research organizations, and membership organizations in an innovative, loose framework offering multi-disciplinary, integrated solutions in agriculture sectors and food systems. WASAG has working groups dealing with water and migration; drought; innovative financing schemes and mechanisms; water and nutrition; and agricultural transformations.

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# Optimizing irrigation requirements for almond trees grown in the South Sinai Governorate

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Evapotranspiration, irrigation schedule, air temperature, evapotranspiration, Penman-Monteith, Blaney-Criddle

**Abstract**

South Sinai, Egypt is considered one of the most severe governorates for water scarcity. The current work aims to optimize irrigation requirements for almond trees (Prunus dulcis, syn. Prunus amygdalus, var. nonpareil) in the El-Tor area, South Sinai. Climate data of the El-Tor area was collected from 2010 to 2014 to calculate evapotranspiration. Two evapotranspiration equations were used in this work: Penman-Monteith (complex radiation equation) and Blaney-Criddle (simple temperature equation). Regression analysis was done between the two equations to determine their agreement and calculate a correction factor in order to make the Blaney-Criddle equation more accurate under South Sinai conditions (modified Blaney-Criddle). Irrigation requirements for one- to five-year-old almond trees in South Sinai were also calculated for the last five years. This study helps the almond farmers estimate the irrigation requirements by using maximum and minimum temperature (Blaney-Criddle) instead of using many climatic parameters (Penman-Monteith). The R2 regression analysis between the two tested equations was 0.95, which means that the suggested correction factor can be used with great confidence. Although there were significant differences between ETo values calculated using Penman-Monteith and Blaney-Criddle, there were no significant differences between the modified Blaney-Criddle (with the correction factor) and Penman-Monteith. This study recommends the use of the modified Blaney-Criddle equation for almond farmers who don't have access to the extensive climate data needed for Penman-Monteith, such as wind speed, relative humidity, sunshine hours and solar radiation. The output of this study is the accurate estimation of monthly irrigation requirements for almonds grown in South Sinai.

## Introduction

Climate plays an important role in crop production. Crop growth periods, water requirements, and irrigation scheduling are all dependent on weather conditions. The useable agricultural land area is determined by climate and water availability. The Agro-climatic zone defines a land unit in terms of major climate characteristics, superimposed on the length of the growing period, i.e., moisture availability period (Food and Agriculture Organization (FAO), 1983). This classification is done using reference evapotranspiration data (ETo). The calculation of the ETo includes all the weather parameters relevant in a specific area. ETo is a combination of two processes: water evaporation from the soil surface and transpiration from the growing plants (Gardner et al., 1985).

Estimates of reference crop ETo rates are widely used in irrigation engineering to define crop water requirements. These estimates are used in the planning process for the development of irrigation schemes as well as to manage water distribution in existing schemes (Droogers & Al-

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**Figure 1:** South Sinai, Egypt (left) and the research area (right) ( Source: Omran et al. (2016))

len, 2002). Many models based on meteorological data have already been developed to estimate ETo in various climatic and geographic conditions. Among these models, Penman–Monteith FAO 56 (PM) was introduced as a standard model to estimate ETo (Allen et al., 1998). The major limitation of the PM model is that it requires many meteorological inputs, thereby limiting its utility in data-sparse areas. Therefore, the application of simpler models is recommended because they only need parameters that are readily available from station-observed meteorological data.

A large number of ETo formulas were developed from 1942 to 2005 to calculate crop water usage, starting with the development of the Blaney-Criddle (BC) formula and ending with the PM equation that became the American Society of Civil Engineers (ASCE) Standardized Reference ETo equation. The BC formula was first developed from soil moisture depletion, air temperature and humidity measurements in alfalfa, cotton, and deciduous trees in farmers' fields by Blaney and Criddle (1950) in the Pecos River, Roswell-Artesia area of New Mexico .

The almond tree (Prunus dulcis, synonym Prunus amygdalu, Family Rosaceae) is a small deciduous tree that grows to 20 to 30 feet naturally, but under cultivation is generally kept to 20 feet by pruning. The almond tree has an average life span of 20-25 years and does not bear fruit during the first 3-4 years after planting (Goldhamer & Fereres, 2004). El Afandi and Abdrabbo (2015) tested four ETo equations in different climatic regions and they mentioned that there were no statistically significant differences between the E-Pan and the PM model at α=0.05, while the BC results differed significantly. The difference in percentage ratios between PM and BC was -13.3%. Hence, the PM equation has proven its capability in the estimation of reference ETo. The aim of the current study is to simplify the estimation of the irrigation requirement for almond trees in the South Sinai governorate by using a modified BC temperature equation with better accuracy.

## Material and Methods

### Climate data

The monthly data from 2010 to 2014 was collected from the automatic weather station of El Tor (latitude 28.23, longitude 32.61, altitude 21m) (**Figure 1**). The monthly data was averaged over the 5-year study period. The climate factors were temperature, wind speed, rain, relative humidity and radiation, which were all used in the estimation of ETo by the PM equation.

### Evapotranspiration estimation models

ETo was calculated by applying the climate data to two models (PM and BC) in order to create a relationship between them.

### Blaney-Criddle equation

The BC equation is as follows (Blaney, Hanson & Litz, 1950):

$ET_0 = p\,(0.46T_{mean} + 8)$

where $T_{mean}$ = mean monthly temperature, calculated as Tmean [°C] = $(T_{max} + T_{min})/2$, and p = mean monthly percentage of maximum possible daytime hours of the year.

### Penman- Monteith equation

The PM equation is calculated as follows (Allen et al., 1998):

$$ET_o = \frac{0.408\Delta\,(R_n - G) + \gamma \frac{900}{T+273} u_2 (e_s - e_a)}{\Delta + \gamma(1 + 0.34\,u_2)}$$

where $ET_o$ is the daily reference evapotranspiration (mm day-1), Rn is the net radiation at the crop surface (MJ m-2 day-1), G is the soil heat flux density (MJ m-2 day-1), T is the mean daily air temperature at 2 m height (°C), U2 is the wind speed at 2 m height (m s-1), $e_s$ is the saturation vapor pressure (kPa), $e_a$ is the actual vapor pressure (kPa), Δ is the slope of the vapor pressure curve (kPa °C-1) and γ is the psychometric constant (kPa °C-1).

### Irrigation requirement

The ETo is determined by the crop coefficient approach, whereby the effects of the various weather conditions are incorporated into ETo and the crop characteristics into the Kc coefficient. In the crop coefficient approach, the crop evapotranspiration, ETc, is calculated by multiplying the reference crop evapotranspiration, ETo, by a crop coefficient, Kc, according to the FAO (1983) and likewise adopted by Allen et al. (1998). Additional parameters can be added to the equation to deliver the irrigation requirement, as follows:

$IR = K_c * ET_o * LF * IE * R * Area / 1000$

where IR = irrigation requirement ($m^3$ $feddan^{-1}$), Kc = crop coefficient, $ET_o$ = reference crop evapotranspiration (mm $day^{-1}$), LF = leaching fraction (assumed 20% of irrigation water), IE = irrigation efficiency of the system in the field (assumed 90%), R =reduction factor, Area = the irrigated area (1 feddan = 0.42 ha), and dividing by 1000 achieves the conversion from liter to cubic meter.

Climate data

**Table 1** shows the monthly weather data of the El-Tor governorate, South Sinai, averaged over the five-year period (2010-2014). The highest monthly average maximum air temperature was recorded during the summer

**Table 1:** Average monthly climatic data for El-Tor, South Sinai from 2010-2014

| Month | Maximum temperature (°C) | Minimum temperature (°C) | Total precipitation (mm) | RH (%) | Wind (m/s) |
|---|---|---|---|---|---|
| Jan | 20.78 | 20.78 | 0.7 | 52 | 2.02 |
| Feb | 22.02 | 22.02 | 1.5 | 53 | 1.51 |
| Mar | 24.66 | 24.66 | 0.0 | 51 | 1.97 |
| Apr | 29.74 | 29.74 | 0.0 | 45 | 2.58 |
| May | 32.72 | 32.72 | 0.1 | 43 | 2.89 |
| Jun | 35.58 | 35.58 | 0.0 | 45 | 2.94 |
| Jul | 35.52 | 35.52 | 0.0 | 62 | 2.89 |
| Aug | 36.06 | 36.06 | 7.4 | 63 | 2.94 |
| Sep | 34.02 | 34.02 | 14.4 | 55 | 1.31 |
| Oct | 32.22 | 32.22 | 0.0 | 53 | 0.90 |
| Nov | 25.84 | 25.84 | 0.2 | 59 | 1.15 |
| Dec | 21.64 | 21.64 | 32.2 | 51 | 1.15 |


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**Table 2:** Average estimated monthly evapotranspiration (ETo) by the Penman-Monteith and Blaney-Criddle equations for El-Tor, South Sinai from 2010-2014

| Month | $ET_o$ Blaney-Criddle (mm) | $ET_o$ Penman- Monteith (mm) | Difference |
|---|---|---|---|
| Jan | 3.4 | 2.8 | -23% |
| Feb | 3.7 | 3.5 | -5% |
| Mar | 4.4 | 5.1 | 15% |
| Apr | 4.5 | 7.6 | 41% |
| May | 5.2 | 9.3 | 44% |
| Jun | 5.8 | 10.3 | 44% |
| Jul | 5.6 | 9.4 | 40% |
| Aug | 5.5 | 9.1 | 40% |
| Sep | 4.9 | 6.0 | 18% |
| Oct | 4.3 | 4.5 | 4% |
| Nov | 3.6 | 3.0 | -21% |
| Dec | 3.2 | 2.2 | -47% |
| Annual average | 4.52 | 6.07 | 26% |
| P-Value | * | * | |

* Significant

months (June, July and August), with a value around 36°C, while the lowest monthly average maximum air temperature was recorded during December, January and February, with a value around 22°C. The monthly average minimum temperature had the same trend as maximum air temperature. The highest monthly average minimum air temperature was around 22°C during June, July and August, while the lowest monthly average minimum air temperature was around 8.0°C during December, January and February. The highest monthly average relative humidity (RH) was recorded in July and August, with a value around 62%, while the lowest RH values were during May, with a value around 43%. The highest total monthly precipitation was recorded in December (32.2 mm), while there was no precipitation during March, April, June, July and October.

### Statistical analysis

Statistical analysis was carried out using SAS software. A paired t–test was used to establish whether there were significant differences (α=0.05) between the $ET_o$ values calculated using different equations (SAS, 2000).

## Results and Discussions

### Estimation of evapotranspiration for El-Tor

Data in **Table 2** shows the estimated monthly ETo by the PM and BC equations for El-Tor from 2010 to 2014. The highest ETo was estimated during June, July and August, while the lowest ETo was estimated during December and January for both tested equations. The BC results were higher than PM for November-February, while the PM equation gave higher values than BC from March to October. Paired t-tests revealed significant differences between the two equations. PM estimated higher annual ETo (6.07 mm) than BC (4.52 mm).

### Regression between Penman-Monteith and Blaney-Criddle equations

**Figure 2** shows the regression of estimated monthly $ET_o$ calculated by the PM and BC equations for El-Tor from 2010 to 2014. Data indicate there is a strong positive relationship between ETo values calculated by the two equations, as indicated by the coefficient of determination ($r^2$=0.95). Using this regression equation, we can estimate $ET_o$ calculated only from air temperature by implementing a modified BC equation with higher accuracy. The derived equation from this regression is as follows:

$$y = 0.1115*X^{2.5998}$$

where y is the ETo according to the modified BC model, 0.1115 is the correction factor, and x is the value of $ET_o$

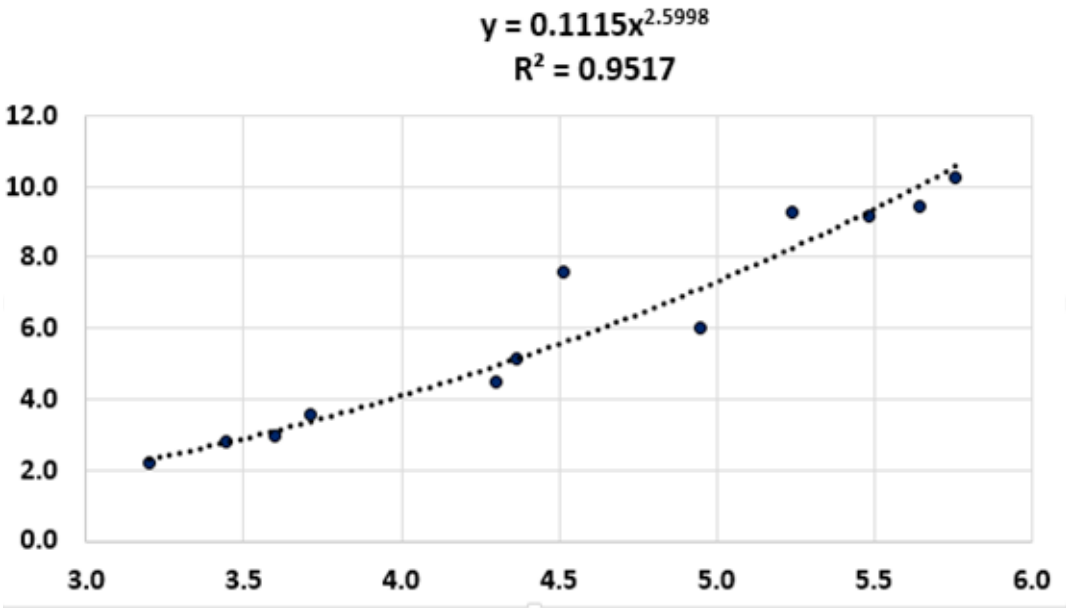


**Figure 2:** Regression analysis for estimated monthly evapotranspiration (ETo) by the Penman-Monteith and Blaney-Criddle equations for the El-Tor Governorate, South Sinai from 2010 to 2014

according to the original BC model.

**Comparison between the modified Blaney–Criddle and Penman-Monteith equations**

Data in Table 3 shows the estimated monthly ETo by PM and the modified BC equation for El-Tor Governorate, South Sinai from 2010 to 2014. The modified BC equation found higher values than PM from June-December, while the PM equation gave higher values than BC from January-May. There was no significant difference between the two tested equations using a paired t-test. The PM had higher annual ETo, with a monthly average of 6.07 mm, while the average for BC was 6.13 mm. The highest difference in percentage between the two equations was found during September (15.7%), while the lowest difference in percentage was during March (0.30%). These results agreed with the findings of Temesgen et al. (2005), who reported that the PM equation is considered a standard method compared to other empirical equations. In addition, Xu and Singh (2001; 2002) indicated that PM is the method which served as the basis for the development of the $ET_o$ calculator software and is considered the most accurate method; therefore, PM is often used as a standard to verify other empirical methods (Allen et al., 2005). Due to the higher performance of PM, it has been accepted as the sole method for computing reference $ET_o$ from meteorological data (Garcial, et al., 2006). The PM equation shows higher performance then the BC equation in different tested regions in Egypt. Therefore, one may conclude that PM could be used in estimation of the reference $ET_o$ over different agro-climatic regions in Egypt with high performance compared to other methods (El-Afandi & Abdrabbo, 2015).

**Irrigation Requirement for almond trees using estimated $ET_o$ values**

Data in **Table 4** show the estimated total monthly irrigation requirements by PM and the modified BC equation for El-Tor Governorate, South Sinai from 2010 to 2014. Total monthly water requirement had the lowest values during the winter season, from December to February. The irrigation requirement increased gradually from March to August, then sharply decreased from September to December. The highest water requirement was estimated during August for both tested $ET_o$ equations. Water requirement under the modified BC was slightly higher than PM estimates, especially during the summer season (June-September). The lowest estimated annual irrigation requirement for almond trees was logically during the first year of growth, with a value of 728 and 742 mm for PM and the modified BC equation, respectively. Annual irrigation requirement increased gradually in the second year of tree growth, while the highest annual irrigation requirement for almond trees was estimated for the fifth year of growth. These results agree with the findings of Goldhamer, Viveros, and Salinas (2006), who mentioned that growers who are interested in reducing irrigation inputs because of water scarcity must determine how to allocate limited fresh water resources. While the studies identified to date quantified effects of the timing of water stress on production, none evaluated different stress timing strategies for applying the given amounts of seasonally available fresh water. In other words, the water application that results in the


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**Table 3:** Average estimated monthly evapotranspiration (ETo in mm /month) by the Penman-Monteith and modified Blaney-Criddle equations for El-Tor Governorate, South Sinai from 2010 to 2014

| Month | $ET_o$ Blaney-Criddle (mm) | $ET_o$ Penman- Monteith (mm) | Difference |
|---|---|---|---|
| Jan | 2.77 | 2.8 | -0.8% |
| Feb | 3.37 | 3.5 | -5.1% |
| Mar | 5.15 | 5.1 | 0.3% |
| Apr | 6.61 | 7.6 | -15.0% |
| May | 8.27 | 9.3 | -12.4% |
| Jun | 10.57 | 10.3 | 2.7% |
| Jul | 10.02 | 9.4 | 5.9% |
| Aug | 9.31 | 9.1 | 1.7% |
| Sep | 7.12 | 6.0 | 15.7% |
| Oct | 4.94 | 4.5 | 9.6% |
| Nov | 3.12 | 3.0 | 4.8% |
| Dec | 2.29 | 2.2 | 5.0% |
| Annual average | 6.13 | 6.07 | 1.0% |
| P-Value | *N.S. | *N.S | |

*N.S Not significant

**Table 4:** Total monthly irrigation requirement (m3 feddan-1 month-1) for almond trees from the first to fifth year of life, estimated by the Penman-Monteith and modified Blaney-Criddle equations for the El-Tor Governorate, South Sinai from 2010 to 2014

| | Penman-Monteith | | | | | Modified Blaney-Criddle | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1st year | 2nd year | 3rd year | 4th year | 5th year | 1st year | 2nd year | 3rd year | 4th year | 5th year |
| Jan | 6.3 | 12.3 | 17.7 | 22.7 | 31.6 | 6.3 | 12.2 | 17.5 | 22.5 | 31.3 |
| Feb | 8.7 | 16.9 | 24.3 | 31.2 | 43.4 | 8.3 | 16.1 | 23.1 | 29.7 | 41.3 |
| Mar | 22.6 | 44.1 | 63.4 | 81.5 | 113.2 | 22.7 | 44.3 | 63.6 | 81.7 | 113.5 |
| Apr | 45.4 | 88.6 | 127.2 | 163.6 | 227.2 | 33.5 | 65.4 | 93.9 | 120.7 | 167.6 |
| May | 92.3 | 179.9 | 258.3 | 332.1 | 461.3 | 82.1 | 160.0 | 229.8 | 295.4 | 410.3 |
| Jun | 111.9 | 218.3 | 313.4 | 403.0 | 559.7 | 115.0 | 224.3 | 322.1 | 414.1 | 575.1 |
| Jul | 131.1 | 255.7 | 367.1 | 472.0 | 655.6 | 139.3 | 271.6 | 390.1 | 501.5 | 696.5 |
| Aug | 145.3 | 283.4 | 406.9 | 523.1 | 726.6 | 147.8 | 288.2 | 413.9 | 532.1 | 739.1 |
| Sep | 82.0 | 160.0 | 229.7 | 295.4 | 410.2 | 97.3 | 189.7 | 272.4 | 350.2 | 486.4 |
| Oct | 59.2 | 115.4 | 165.7 | 213.0 | 295.9 | 65.4 | 127.6 | 183.2 | 235.6 | 327.2 |
| Nov | 18.5 | 36.1 | 51.9 | 66.7 | 92.6 | 19.5 | 37.9 | 54.5 | 70.0 | 97.3 |
| Dec | 4.9 | 9.6 | 13.8 | 17.7 | 24.6 | 5.2 | 10.1 | 14.5 | 18.7 | 25.9 |
| **Total** | **728** | **1420** | **2039** | **2622** | **3642** | **742** | **1448** | **2079** | **2672** | **3712** |

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most successful production system for a given fraction of the seasonal potential water needs has not been studied precisely. Moreover, accurate knowledge of water loss through crop evapotranspiration (ETc) is essential in order to avoid mistakes in estimating crop water needs, especially in areas suffering from water scarcity and drought. Deficiencies in the irrigation system are related to inappropriate irrigation estimations, which cause higher costs, wasted irrigation water, as well as negative environmental repercussions (Katerji & Rana, 2011). In arid and semi-arid areas, irrigation can be the main limiting factor in almond trees production (Hutmacher et al., 1994). In this context, the application of irrigation systems in rain-fed areas is considered an opportunity to improve the productivity of almond trees. In addition, Allen et al. (1998) reported that plants are exposed to a host of variables related to temperature which affect crop production, e.g., evaporation, transpiration, and vapor pressure deficit. Even solar radiation is related to the diurnal air temperature difference. Increasing air temperature leads to increased $ET_o$, depleting the soil of water, thus increasing the need for irrigation (Abdrabbo, Farag & El-Desokey, 2015; Farag, Abdrabbo, Ahmed, 2014). Furthermore, current Egyptian water policies are not made clear enough by the government. Research reflecting current policies may thus be particularly relevant in determining possible future steps. This is based on the 2005 Integrated Water Resources Management Plan and Water for the Future: National Water Resources Plan 2017, the latter of which was supported by the Dutch Government. In these documents, the stated major concerns are water for people, food production, industry, services, and employment; developing a strong institutional framework; quality, supply, and demand management; and protection and restoration of vital ecosystems (Farnum, 2014). These conditions demonstrate a vital need for accurate estimation of water requirements for different areas in Egypt in order to develop a better strategy for the future. Without appropriate water management, irrigated agriculture can be detrimental to the environment and endanger sustainability. Irrigated agriculture is facing growing competition for low-cost, high-quality water. In irrigated agriculture, water use efficiency is broader in scope than most other agronomic applications and must be considered on a watershed, basin, irrigation district, or catchment scale (Howell, 2001).

## Conclusion

Under the semi-arid conditions of South Sinai, each water drop has a great value, not just in terms of agriculture, but for all aspects of life. Agricultural production that follows the deficit irrigation optimization strategy can contribute strongly to sustainable development and food security. The study results reveal that a modified Blaney-Criddle equation can estimate the irrigation requirements of almond trees under South Sinai conditions with simplicity and high accuracy compared to reference evapotranspiration rates calculated with the complex Penman-Monteith equation. The modified Blaney-Criddle equation uses only readily available climatic factors, namely maximum and minimum average monthly temperature, for estimating evapotranspiration. Therefore, agricultural extension associations, NGOs, and almond growers can use temperature data to estimate accurate irrigation requirements. Further studies are needed to investigate the effect of water deficit on the productivity of almond and quality of almond fruits. In addition, more research is needed related to water management for all cultivated crops in South Sinai alongside the impacts of implementing deficit irrigation in agricultural production.

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## Conflict of Interests

The authors hereby declare that there is no conflict of interests.

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# Veganism as a Virtue: How compassion and fairness show us what is virtuous about veganism

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**Abstract**

With millions of animals brought into existence and raised for food every year, their negative impact upon the environment and the staggering growth in the number of chronic diseases caused by meat and dairy diets make a global move toward ethical veganism imperative. Typically, utilitarians and deontologists have led this discussion. The purpose of this paper is to propose a virtuous approach to ethical veganism. Virtue ethics can be used to construct a defense of ethical veganism by relying on the virtues of compassion and fairness. Exercising these values in our relations with animals involves acknowledging their moral value, thus seeing that they are not our property or our food. It is important to emphasize that this argument applies only to well-developed societies that need not rely upon animals as sources of food, clothing, and various by-products.

## Introduction

Veganism is the moral attitude according to which we should avoid using animals as sources of food, clothing and by-products, such as eggs, dairy products, honey, leather, fur, silk, wool, cosmetics, and soaps derived from animals. Some vegans additionally claim we should categorically avoid products tested on animals; I call this view "absolute veganism." Here, I will not defend such a view. I will attempt to defend veganism as a way that promotes a more humane and caring world. Such a view acknowledges that we are not perfect, but believes that we have a responsibility to try our best to avoid using animals.

Both utilitarians and deontologists have made us question our treatment of animals. However, millions of animals are still being exploited. The reason is very complex, but the beginning of an explanation is that the wrong advocates for animals have been leading the discussion. Singer, Regan, and like-minded philosophers have to be given credit for bringing the discussion to light and urging us to question the morality of our relationship with animals. However, their essentialist approach has serious limitations that has caused a delay in acceptance. Their arguments, which rely upon utilitarian calculations of overall preferences (Singer, 1975; Singer, 1980; Singer, 1993), rights (Regan, 2004) and duties (Korsgaard, 2004; Korsgaard, 2009), have been incapable of motivating us to accept the abolition of factory farming, hunting, and animal experimentation.

Regan and others rely on conceptions of rights and duties that are flawed. Regan argues that we should focus on the similarities rather than the differences between animals and ourselves. Both Regan and Singer, though they propose different ethical accounts, share the idea that there is no morally relevant difference between animals and humans that could justify animal exploitation. Therefore, Regan argues that because animals are subject to a life like humans, in the sense that they feel and have desires and a variety of experiences just like us,

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and because they can be harmed just like humans, they also have a value that should be respected. The difficulty with these types of arguments is that the symmetry they propose between human and non-human animals is questionable. Perhaps it is a form of anthropomorphism to argue that our experiences are similar to those of animals in a way that is relevant to morality. As a matter of fact, many people find this symmetry argument unconvincing, and are unmoved toward veganism. The trouble is that, while it is true that animals suffer, this is not, by itself, enough to show that humans and animals are relevantly similar so that human and animal suffering should have equal moral importance.

Consequently, a number of contemporary philosophers have emphasized the importance of a virtuous character and acquiring the virtues over obeying moral prescriptions derived from universal principles or duty. However, the discussion of how a virtuous character leads to embracing ethical veganism has not yet been properly considered. Husthouse (2006; 2011) illustrates how we can account for the ethical treatment of nonhuman animals through an appeal to virtue ethics. She claims that starting with the question of moral status is not correct in the animal ethics discussion. Rather, we should begin by morally questioning the attitudes that underlie the use and abuse of non-human animals. When we do so, we often find that we act viciously. Thus, if one is committed to living a virtuous life, he or she will change his or her attitudes toward the use of animals. Abbate (2014) entertains the idea that virtue ethics, rather than utilitarianism, duty, or rights, is the appropriate framework for developing an animal liberation ethic. Her claim is that utilitarianism is overly permissive because it permits the harming of animals for trivial reasons, so long as interests are maximized. On the other hand, deontological theory is too restrictive, since the prohibition on harming non-human animals would make moral agents incapable of responding to moral tragedies that, at times, require that some animals be harmed in order to prevent more harm. Virtue ethics has a wealth of insights that could motivate people to become vegans, yet virtue ethicists have never offered a virtuous defense of ethical veganism. My thesis is that the acquisition of the virtues of compassion and fairness may make us see what is virtuous about ethical veganism. However, it is important to understand that my argument applies to those who live in affluent societies, who have an abundance of readily available plant-based food. I will not, therefore, say anything about those societies that have no other alternatives but to rely upon animals as sources of sustenance. To show why a virtuous approach is preferable, I shall first examine Korsgaard's duty view and Singer's preference utilitarianism to show their shortcomings.

**Korsgaard: A Neo Kantian View**

To begin with a duty approach, Korsgaard's lecture "Fellow Creatures: Kantian Ethics and Our Duties to Animals" (2004) attempts to show how Kantian ethics can grant moral duties toward animals. She argues that if Kant had been consistent, he would have realized that animals are in a sense ends-in-themselves. The problem is that Kant's ethical system is rather strict because, accordingly, only agents that have a rational nature can constrain us morally. By rational nature, Kant refers to "…our capacity to govern ourselves by autonomous rational choice" (Korsgaard, 2004, p. 3). Humans are rational creatures who form what Kant calls the "Kingdom of Ends." In the Kingdom of Ends, each individual is autonomous and capable of creating and understanding moral laws. Consequently, we humans have a duty to treat all members of our Kingdom with respect. Unfortunately, animals are not moral agents because they are not rational in a way that they could ever govern themselves by autonomous rational choice. Therefore, in terms of Kantian ethics, this means that we do not have any moral duties to them, at least directly.

Kant's view is an argument "from the capacity to obligate, or the lack of that capacity, to the assignment of a certain kind of value" (Korsgaard, 2004, p.16-17). In other words, Kant does not want to say that animals have no value at all, but rather that they are not capable of obligating us to respect moral laws. With regard to the question of whether animals are in fact capable of placing us under moral obligations, Korsgaard thinks that they are, though it appears to be the contrary. Korsgaard's thesis is that "…despite appearances, and despite what he himself thought, Kant's argument reveals the ground of our obligations to the other animals" (Korsgaard, 2004, p. 5). Korsgaard argues that Kant conflates two conceptions of "end-in-itself." One is the source of normative claims recognized by all rational agents, and the other sense is someone who is able to give force to a claim by participation in morality. Surely animals cannot be ends-in-themselves in the second sense, because they lack rationality and autonomy; they do not participate in morality. However, it does not follow that non-human animals cannot be ends-in-themselves in the first sense: as the sources of normative claims. It does not follow, Korsgaard says, that "there is no sense in which they can obligate us." (Korsgaard, 2004, p. 21) There is, in fact, a sense in which animals obligate us.

We take ourselves and our interests to be the source of morality. But we do not value our interests only because they are the interests of autonomous rational beings. Being autonomous and rational allows me to legislate against what is bad for me and others like me. However, I

do not legislate, for example, against being lied to, being injured, being cheated on, etc., only because I am an autonomous and a rational being, but also—perhaps most importantly—because bad things assault my animal nature. In other words, "we object to pain and torture or injury because they are bad for us as animal beings" (Korsgaard, 2004, p. 28). In fact, Kant holds that respect for our rational nature involves respecting our animal nature. This is the ground for his arguments about our duties to ourselves, our self-preservation, the enjoyment of food, and sex. In Kant's Groundwork for the Metaphysics of Morals (1997), the section entitled "A Human Being's Duty to Himself as an Animal Being" (p. 421-428) discusses duties to ourselves as animal beings with respect to our animal nature, not rationality. He covers the duties not to commit suicide, not to maim or disfigure oneself, not to masturbate, and not to indulge in excessive consumption of food or drink. In Religion Within the Boundaries of Mere Reason, Kant (2001) argues that our animal nature is one of three "original predispositions to good in human nature" (p.74). Thus, for Korsgaard, our autonomous nature is not the only source of normative claims. Besides our autonomous nature, we derive normative value from our animal nature.

The duties we owe to ourselves arise from the natural fact that many things can be objectively good or bad for us, for example, pain and suffering. Thus, while it is true that animals are not self-legislative beings capable of imposing laws upon us, it does not follow that we owe no moral duties directly to them. In fact, animals, like us, are beings for whom things can be good or bad. Therefore, Kant is mistaken because he does not recognize this. As Korsgaard puts it, "…human incentives are simply the same as those of the other animals" (Korsgaard, 2004, p. 32). She also reminds us that Kant does not believe that humans are magnificently unique in the sense that their nature is transcendental unlike animals (Korsgaard, 2004, p. 33). Humans are not morally superior in this sense for Kant. Rather, humans are able to legislate that the things that are good for us are the source of normative claims. This is certainly one sense in which humans are ends-in-themselves; the other sense is that they have an animal nature. Thus, animal nature is an end-in-itself—and it follows that we have direct duties to other animals.

For Korsgaard, Kant was wrong about claiming that only rational beings can place us under moral obligation. However, I doubt that Korsgaard's attempt is successful. Korsgaard's success in showing that we have direct duties to animals on Kantian grounds hinges on the question of whether Kant in fact overlooked the implications of his own principle. I do not think it is clear that Kant would concede that having an animal nature is morally important, because when we legislate against things that assault us, we in fact make laws against them because they assault our animal nature. Kant may argue that having an animal nature may be a sufficient condition for having direct duties to other rational beings, but not a necessary condition. Our animal nature is, after all, "attached" to a rational nature, whereas animals (according to Kant) are completely devoid of a rational nature—and that is why they cannot put us under moral obligation, i.e., we do not have direct moral duties to them.

Korsgaard's view on our duties towards animals fails as a moral theory in favor of animals because her view is ultimately concerned with notions of obligation and right conduct. The problem is her conception of morality as a set of universal and authoritative norms by which all moral agents are categorically obligated to follow. Korsgaard argues in an interview with Schaubroeck (2009),

> Morality assigns us purposes, it is our moral duty to help those in need for its own sake—not to help those in need for something else. We are creatures who adopt our purposes—they are not given to us by our desires, and that means we need principles to guide their adoption. (p. 55)

To show why Korsgaard's moral outlook about our treatment of animals fails, I want to consider Stocker's criticism of duty-based theories. Stocker (1976) goes directly to the heart of the problem as he writes,

> These theories [referring to Kantian and utilitarian ethics] are, thus, doubly defective. As ethical theories, they fail by making it impossible for a person to achieve the good in an integrated way. As theories of the mind, of reasons and motives, of human life and activity, they fail, not only by putting us in a position that is psychologically uncomfortable, difficult, or even untenable, but also by making us and our lives essentially fragmented and incoherent. (p. 455)

As Stocker points out, a theory that emphasizes duty leads us to moral schizophrenia. Imagine that you are in a hospital, recovering from an illness. Your friend, Smith, comes in to visit you, and this makes you happy. However, you find out that Smith is unenthusiastic about visiting you. In fact, he'd rather be somewhere else. He came to see you not because he has a desire to see you or he loves you and he is concerned about your health, but rather, as it turns out, because he is a deontologist who is committed to acting out of duty, regardless of how he feels about a certain action. Now think about this moral outlook when applied to the treatment of animals. Such a moral view asks us to respect animals because we should recognize that we have certain moral duties toward them. Such a theory of supposed duties is neither able to convince many, nor to motivate those who might be convinced. It appears clear that duty ap-


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proaches distort our view of morality because they focus on duty rather than the individual themselves.

**Utilitarianism and Unreasonable Demands**

Having considered a duty view, I shall now consider preference utilitarianism. Singer's preference utilitarianism takes the right action to be the one whose consequences promote the preferences of beings that have preferences, namely, sentient beings. Singer uses his preference utilitarianism to show that humans have a moral obligation to stop raising animals for food and stop using animals as subjects for scientific research. His ideas are mainly found in *Animal Liberation* (1975) and *Practical Ethics* (1993). These two works, among others by Singer, have played a vital role in shaping the contemporary animal rights movement and the philosophy of vegetarianism.

According to preference utilitarianism, the right action, rather than calculating pleasure against pain, is one that promotes the best interests of the greatest number. Based on this ethical view, Singer (1980) claims that "applying the principle of utility to our present situation—especially the methods now used to rear animals for food and the variety of foods available to us—leads to the conclusion that we ought to be vegetarians" (p. 137). But is it true that utilitarianism makes a strong demand of us to become vegetarians and to shun animal exploitation? In what follows, I want to show that utilitarianism is not a viable moral system to claim and support the rights of animals and does not lead necessarily to vegetarianism; in fact, that utilitarianism does not underwrite concern about the welfare of animals at all.

A statement that Singer (1993) makes in the early pages of his Practical Ethics adroitly captures his view:

> The way of thinking I have outlined is a form of utilitarianism. It differs from classical utilitarianism in that 'best consequences' is understood as meaning what, on balance, furthers the interests of those affected, rather than merely what increases pleasure and reduces pain. (It has, however, been suggested that classical utilitarians like Bentham and John Stuart Mill used 'pleasure' and 'pain' in a broad sense that allowed them to include achieving what one desired as a 'pleasure' and the reverse as a 'pain'). (p. 14)

While for Kant, rationality is the locus of morality, according to utilitarianism, sentience is the starting point of moral consideration, the special characteristic that confers upon a being moral worth. As explained by Singer (1993),

> If a being suffers, there can be no moral justification for refusing to take that suffering into consideration. No matter what the nature of the being, the principle of equality requires that its suffering be counted equally with the like suffering—in so far as rough comparisons can be made—of any other being. ( p. 15)

For utilitarians, if a being can feel pain and pleasure, it is a sentient and moral agent, and consequently it counts morally. Therefore, what this means is that not only humans are moral agents worthy of moral consideration, but many animals, as well.

Diamond (1978) makes a valuable point about Singer's approach. She points out that Singer's position contains "fundamental confusion about moral relations between people and people and between people and animals" (p. 466). She says that the analogies used in these types of arguments are not clear at all, and thus it is difficult to see how they move from consideration of human preferences to consideration of animal preferences. Moreover, the argument prevents us from seeing what is really important in our relations with other people and with animals. What's fundamentally wrong with this kind of argument is that it begins by asking the wrong question: What grounds do we have to claim that humans have certain rights while animals do not? For it asks why we don't kill people or inflict suffering on them, while we are willing to do just that to animals. Diamond (1978) argues, "This is a totally wrong way of beginning the discussion, because it ignores certain quite central facts—facts which, if attended to, would make it clear that rights are not what is crucial" (p. 467).

We do not eat people (typically), but not because of utilitarian principles, i.e., because they have preferences, and they prefer not to be eaten. Rather we don't eat people simply because we do not regard them as food. Even if people wouldn't mind being eaten, and they died in accidents, and human flesh were delicious and nutritious, we would still not eat them. But then it seems that Singer's argument is uneven, because it suggests that we do not maltreat other human beings or animals because they have preferences by virtue of their being sentient. However, if the analogy holds for animals, and demands that we not eat them or experiment on them because doing so may deprive them of their preferences, thus negatively affect aggregative utility, then this principle should also hold for humans. Namely, eating people would turn out not to be permissible because it deprives humans of their preferences. But again, this is clearly not the reason we do not eat people. Anyone who argues this way, Diamond (1978) says, "runs a risk of leaving altogether out of his discussion those fundamental fea-

tures of our relationship to other human beings which are involved in our not eating them." (p. 467)

My objections to Singer's moral approach are, by and large, in line with Diamond's, though it seems to me that there is even more to be said on the topic than Diamonds and others have said. While utilitarianism is theoretically appealing, I want to propose that no one really lives this way. Suppose a person dear to you is hopelessly ill. As a utilitarian, it might turn out, upon calculation, that you should let her die so as to maximize utility by using the money and care required to look after her to diminish the suffering of many others. In the 1999 profile by Michael Specter featured in The New Yorker, Singer makes it very clear what he thinks about such a situation, as he states, "The notion that human life is sacred just because it's human life is medieval." Regarding the hopelessly ill, he states, "The person that used to be there is gone. It doesn't matter how sad it makes us. All I am saying is that it's time to stop pretending that the world is not the way we know it to be" (p. 55). Singer argues that the idea that human life is sacred is obsolete. But what are the results of approaching morality this way?

Highly rational and impersonal theories do not help us understand the moral worth of humans and animals. In fact, when an individual close to us is very ill, our response is seldom controlled by the rational, preference-calculating, utilitarian principles, but rather by our virtue. As Donovan (2006) writes, "sympathy, empathy, and compassion [are] relevant ethical and epistemological sources for human treatment of nonhuman animals" (p. 306). The calculations that utilitarianism makes, while theoretically attractive, hardly apply in real life. About this issue, Williams says,

> You can't make these calculations and comparisons in real life. It's bluff... One of the reasons his [Singer's] approach is so popular is that it reduces all moral puzzlement to a formula. You remove puzzlement and doubt and conflict of values, and it's in the scientific spirit. People seem to think it will all add up, but it never does, because humans never do. (Specter, 1999, p. 55)

The last words of the above citation, "because humans never do" are crucial: morality conceived as a formula fails because abstract reasoning cannot capture the moral complexity of humanity. Moral puzzlements require more than formulas; they require attentiveness, love, care, and a conception of human beings as intrinsically valuable. In Practical Ethics, Singer (1993) writes, "ethics is not an ideal system that is noble in theory but no good in practice. The reverse is closer to the truth: an ethical judgment that is no good in practice must suffer from a theoretical defect" (p. 2). It would seem, then, that if utilitarians are sincere in their desire to propose a moral view that is noble in theory and good in practice, they must abandon their view that calculation of utility is all we require if we wish to deal with moral issues. Thus, I argue, utilitarianism is not a viable ethical theory that can be applied to the question of our treatment of animals because it ignores our love for, and relationship with, animals and people, at the expense of satisfying preferences or happiness for the greatest number.

## Virtue Ethics

Virtue ethics (VE) maintains that our moral experience and our relation with others are too complex, too nuanced, and too textured to be captured and understood by a set of principles or rational calculation. When we theorize, we detach ourselves from our moral experience and our moral feelings. In the Greek myth, Procrustes offered his bed to guests who wanted to spend the night. If the guests were too long for the bed, Procrustes would chop off their legs; and if they were too short, he would stretch them so that they could fit. Deontology and utilitarianism have done to morality what Procrustes used to do to his guests. VE, therefore, believes that the correct way to understand and approach morality is to consider each situation and determine what the appropriate moral approach should be and which action should be carried out. Most importantly, VE recognizes that people's motives, character, and reasons for acting in certain ways are more important than any theory that claims to give moral directions. In other words, if people are honest, fair, compassionate, just, and more, by virtue of their characters, they will do what is right, for the right reason, in a given circumstance.

VE emphasizes the kind of person one is. There are important factors in morality: whether an intention is right, whether one is following the correct rule, or whether the consequences of action are good. But these factors are not primary. What is primary is whether the individual's actions are expressions of good character. When we help a friend, for example, we do so out of friendship and not for the sake of it. According to VE, if you are my friend, I help you because I like you and care about you and take pleasure in helping you, and not because I think that I have a moral duty to help you or because it turns out that my helping you will maximize overall utility. This aspect of VE is one of the main points of disagreement between VE and nor-aretaic moral theories. VE regards a virtuous individual as someone who has the virtues; virtues have morally right desires built in. In Book II.1 of Nicomachean Ethics, Aristotle (1990) discusses the question of how one acquires moral virtues, "the virtues . . . we acquire by


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having first put them into action" (II.2.1103a30). This is possible because the capacity for virtue is innate, but has to be brought to a fully developed state through practice. For example, it is by repeatedly performing generous acts that one develops the virtue of generosity; it is by repeatedly refusing to indulge one's appetite that one develops the virtue of temperance. However, not every generous or temperate act is virtuous. If I spend my entire paycheck to buy a friend a car or if I refrain from eating all together, or I eat far too much, then I am not doing what is virtuous. Also, consider courage: being courageous is not to lack fear, but to perform in spite of fear. But if I express my courage by robbing a bank, I am not exercising my courage in a way that is virtuous. Why? Simply because robbing a bank is an action proceeding from a vice that goes against other virtues, such as justice. According to VE, the best ways to promote social cooperation and harmony is for people to acquire a good, reliable character. Rules by themselves may give guidelines, but they cannot make people good. Consequences of our actions are important, but without good intentions, we are not likely to produce greater total satisfaction than other theories try to achieve by detached theorizing.

## How Compassion and Fairness Make Us Understand What is Virtuous about Veganism

People use animals for food, clothing, cosmetics, scientific research, and many other purposes. Unbeknown to many our relationship with animals is cruel and immoral. The reality is that we bring into existence and raise millions of animals in cages, feed them poisons and chemicals, cut them into pieces of various shapes and forms, cook them, and consume their flesh. All this happens before our eyes without our realizing its viciousness. As I will argue, morality is about having a noble character. What we do to animals, anyway we word it or try to justify, is ignoble.

I believe that virtue ethics may lead us to the conclusion that those who live in affluent societies, who enjoy an abundance of plant-based foods, should become vegans. VE does this by showing the necessity to have, among many others virtues, compassion and fairness, both of which enable a sensitivity to unnecessary cruelty and suffering. If one acquires these virtues, he will be compassionate, sensitive to cruelty, resist injustice, and possibly see that veganism is a virtuous practice. The practices of eating animals and using them in various aspects of our lives often entail vices, such as intemperance, cruelty, injustice, and lack of compassion and empathy. I am not suggesting that there are absolute rights and wrongs; that is not the project of virtue ethics. The main characteristic of the virtuous person is that he or she does the best thing in a situation, all things considered. But if virtue ethics is correct in saying that what is important in morality are a good moral character and acting out of virtue, rather than worry about duty or the way to reduce the total amount of suffering in the world, what are the virtues that illuminate our understanding that veganism is a virtuous practice? Although many virtues could be appealed to, I want to consider, in particular, the virtue of compassion and the virtue of fairness.

### *Compassion*

Compassion is a virtue rooted in love; it is a deep concern about the pain of the sufferer, with the hope of alleviating it and that some positive good will emerge from the sufferer's unfortunate situation. In fact, compassion is also a deep concern for others' happiness and joy. Helping others who are suffering is very important; it is what a compassionate person does. But it is equally important to take positive action to increase or maintain others' happiness. Since animals are capable of suffering or living a pleasant life, a compassionate individual would avoid practices that cause pain to animals and also would try to maintain their happiness. A true virtue, after all, strives to produce a good life for us and for others. A compassionate individual feels sympathy for those who suffer. Sympathy is an important moral feeling because it allows us to respond to something unfortunate or unpleasant happening to others. When an elderly person is entering a building, a sympathetic person will hold the door for him. When an animal is hurt, the sympathetic person will offer help. But most importantly, a compassionate person has empathy. Empathy is related to sympathy, but goes deeper in that it "recognizes connection with an understanding of the circumstances of the other" (Gruen, 2014, p. 45). An empathetic individual tries to understand thoroughly the situation and circumstances of others and cares about their well-being. These 'others' may be close to us or far away, other humans or non-human animals. Empathy enables us to extend our love to victims of some natural catastrophe, for example, who may live on the other side of the world. In the case of our treatment of non-human animals, the compassionate individual has empathy for them and tries to understand what matters for them. Thus, a compassionate individual understands that animals exist for their own benefit and do not desire to die or to be turned into food or spend their existence inside a cage. A compassionate individual, therefore, will not merely try to alleviate the pain of an animal who, for instance, is about to be slaughtered by caressing him or by giving him a tranquillizer or by making his death as quick as possible. This would not be the full expression of compassion. Rather, a compassionate, empathetic individual also recognizes that animals do not only wish to avoid pain, but also wish to survive and flourish. Consequent-

ly, by definition, a compassionate person would oppose all forms of animal exploitation. But just like other virtues, compassion seems to lie between two excesses. One way, for example, an individual would be too compassionate is by putting his own well-being at risk. For example, it would be a form of excess of compassion if one refused to wash his hands to protect germs, or if he denied food to his children to feed strangers, or allowed rats to take over his apartment. On the other hand, one would not be compassionate enough if he deliberately killed animals for fun, or just for the sake of it; or, having an abundance of food, he refused to share it with others in need. In the present case, veganism is the idea that animals do not belong to us and thus they are not food or property. Considering that humans can thrive on a vegan diet, and considering that the animals that people eat are domesticated farm animals, the compassionate individual will avoid eating those animals or any other practice that involves animal by-products.

A person may be thought to be compassionate because she cares about humans and animals within her own circle. For example, many people consider themselves compassionate individuals and animal lovers. However, their compassion is limited to the people around them and their pets; the limit of their compassion is evinced by the fact that they may eat meat. This attitude is not, however, a virtuous one. Compassion must be consistently extended to all animals and people outside one's moral circle. The failure to extend compassion to all animals—not just to companions—creates an incompleteness of the virtue. For VE, it is not sufficient to be compassionate only in some instances (Hursthouse, 1999, p. 14). Therefore, one may not claim to be compassionate in the complete sense of the virtue if one's actions are directed only toward humans or a restricted circle of animals. One must be thoroughly and consistently compassionate toward all beings. One is not truly compassionate by simply refraining from directly being cruel to or directly exploiting animals. One must also not be party to the exploitation of animals; he must not purchase leather, fur, meat, or choose to remain ignorant or inactive by shrugging it off and saying that he cannot do anything about it.

Since an important component of compassion is empathy, a compassionate individual recognizes and appreciates the unique characteristics and needs of everything and everyone. When we are attentive to the needs of others, and thus realize that the lives of people, and of many animals, are important to them, we are moved to value their lives and happiness and we desire to relieve their suffering and to further their happiness. Therefore, compassion makes us understand that veganism is a virtuous practice.

***Fairness***

It seems that virtually all people who care about morality want to be or strive to be fair. But what does that mean? If we stand in a long line and one person tries to cut into the line, we say it's unfair. Exploiting people is unfair. Hurting a child intentionally is unfair. Hurting a dog is unfair. The fair-minded individual acts out of justice to ensure that everyone receives what he or she deserves. Treating others fairly means ensuring that they receive the deserved reward or punishment. A fair individual does not exploit others for his own benefit; he tries to be impartial by treating others equally. If exploiting humans or causing suffering to them is wrong, but it is not considered wrong in the case of animals, this is not impartial. The fair individual is fair to all individuals regardless of their skin color, nationality, height, age, species, and so on. Eating and using animals causes countless animals to suffer and be killed for trivial reasons, such as taste, fashion, and amusement. In affluent societies, where food is abundant and we have no need to use animals for food or clothing, our treatment of animals is, by definition, especially unfair.

We cause animals to suffer because we use them. Animals experience the world. They are individuals. They don't want to be used by us, but rather enjoy their existence the same way we want to enjoy ours. And once again, consider that to have good lives, we don't need to use animals for food or other purposes; that eating animals and their by-products can be bad for our health; and that intensive livestock production can harm the environment. It follows that tradition, convenience, and taste are not good reasons to use animals, even 'humanely.' If we are consistently fair, we will not merely try to ameliorate their living conditions, but rather avoid exploiting them in the first place. Using their bodies, their skin, their milk, their fur, or their eggs is unfair. Also, using some animals but not others is unfair. In Western societies, dogs, cats, some birds, and some fish are considered pets; but other birds, fish, cows, and pigs, are considered food. Of course, being a pet does not entail that an animal is treated well. The vast majority of pets are also treated callously. However, the only way to be fair is not to use animals at all. Again, this does not mean that we should endanger our health by allowing lice to proliferate in our hair or cockroaches in our apartments. Because VE does not require moral absolutes, it is consistent with fairness that we should not intentionally destroy or harm other living beings; but, by the same token, it would not be fair to allow other organisms to harm us. In the case of lice, for example, if possible, one should try to remove them without harming them. Shaving one's hair seems to be a fair compromise. Thus, fairness entails that we should not exploit or intentionally hurt or kill, which means going vegan. Therefore, fairness also shows that veganism


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is a virtuous practice and lifestyle.

**Where We Draw the Line**

A skeptic of the idea that we should all become vegans may point out that being virtuous does not guarantee that we embrace veganism. One may ask, "But where do we draw the line?" Veganism, as I see it, is the idea that animals do not belong to us. This implies that using them is immoral. But which animals are we talking about? All animals? All insects? Where do we draw the line of respect for animals? These questions seem to me to make sense in a context of an ethic that emphasizes universal rules or one that proposes a common denominator for respecting animals, such as sentience, as the locus of morality. The point of VE is not to draw lines because, as I have explained, VE is a moral approach that deemphasizes universal rules and consequences and focuses instead on the character of the agent. An agent who has a consistently benevolent, compassionate, temperate, and just character will always behave in ways that are benevolent, compassionate, temperate, and just. He or she will always act well. Conversely, an agent who is not virtuous will have to rely upon and follow universal rules or prescriptions derived from some utilitarian calculus; but there is no guarantee that the agent will be willing to act according to those rules or that the agent will be satisfied by his required actions. When we approach morality from virtue, we are asked to take into account the relevant facts of a given situation, rather than abstracting those facts. In other words, a utilitarian, for example, may propose that in our dealings with animals, we give equal consideration to all those beings that have preferences. The utilitarian, then, may draw a line and declare that, because a fetus or a mosquito are not the kinds of beings whose preferences could be satisfied or frustrated, we cast them outside the moral community. Kantian ethics is another perfect example of this. According to Kant, the so-called line has to be drawn in accordance with rationality; and since animals are not rational, we have no direct moral duty to them.

VE sees the issue differently. A compassionate individual, for example, is concerned about the well-being of all living things. He respects all creatures because all have a dignity and deserve moral respect. For a virtuous individual, it is not the case that only certain beings have moral worth, while others are absolutely worthless or irrelevant. This is an attitude embedded in the virtues. A virtuous individual respects insects in that he does not kill them intentionally or take pleasure out of torturing or killing them. Since he also respects nature, he will not destroy plants needlessly or pollute waters. At the same time, VE is consistent in its approach because it does not categorically prohibit killing animals who threaten our lives or insects that, for example, might infest our homes. In such circumstances, a virtuous individual is morally consistent. With regard to veganism, considering that we can conduct our lives without using animals for food, clothing, or other purposes, exploiting them is inconsistent with the virtues.

VE leads to ethical veganism because the virtuous person is compassionate and fair, which entails the avoidance or reduction of violence humans perpetrate against other living beings. It is a more nuanced attitude than simply drawing lines. Rather, it is an approach that invites us to fine-tune our dietary practices in keeping with the philosophical and moral considerations of what all living beings are, what they are capable of, and what our relation to them is and should be. Returning to the idea of compassion, I argued that a compassionate individual is concerned about the well-being of all living things. He or she respects all creatures because all have a dignity and deserve moral respect. So, one may object that since plants are also exploited and used as food, it would seem to follow that a virtuous individual would also avoid eating them.[1] In other words, why is eating plants compassionate but eating animal by-products is not? I think the answer starts by considering that the actions of a virtuous individual are measured according to the given circumstances. Compassion is applied in different degrees according to the particular living organism. This means that while a compassionate individual has moral respect for all living things, the degree of respect is different for different beings and different situations.

Considering the cognitive capacities that animals have, and considering the horrendous practices required to turn animals into food, it is reasonable to say that a compassionate individual avoids using animals because it causes pain and suffering to them. In this case, a compassionate individual may consistently eat plants but avoid eating animals and their by-products because using plants does not require those painful practices that I outlined above. It might turn out that plants have certain important cognitive capacities, that they are sentient; but it is reasonable to say that it is more compassionate to use them than to exploit animals who exhibit a higher degree of sentience and conscious experience of the world. Namely, unlike plants, animals are social creatures possessing cognitive capacities, by virtue of which they experience the world. We see that they are not mere objects but beings that experience feelings of fear and joy, and have relationships with friends and with their own offspring.

[1] For a discussion of plant ethics, see Marder (2013)

***Plants are alive and feel pain, too***.

Why vegans eat plants. Granted, plants are living organisms. A compassionate individual, then, must make a choice between eating animals and their by-products or eating plants. The compassionate approach is to choose to use those organisms that are less likely to be morally disrespected. For plants, "being alive" is different from that of animals in a way that makes it difficult to see in what sense it could be said that we wrong or disrespect a plant by eating it. Rice, mangoes, beans, bananas, lettuce, or broccoli do not seem to have conscious experiences or to be concerned about their existence. It is very unlikely that they enjoy life and the company of their parents and friends, like animals and people do.

Furthermore, the most important aspect of VE as it relates to the question of whether plants can feel pain, and whether veganism is a compassionate moral position is this: VE concerns organisms that are alive, but it also concerns nature. It is not the case that a virtuous individual would have no moral feelings or respect for mountains and water, but only for living and breathing organisms. This is a mistaken conception of VE. As Murdoch (1970) argues, "The moral life…is something that goes on continually, not something that switches off in between the occurrence of explicit moral choices. What happens in between such choices is indeed what is crucial" (p. 8). The virtuous individual is respectful of all things—mountains, rivers, and the whole of nature. His eating choices are informed by virtue and his actions are always appropriate in relation to the good of not only himself, but also nature as a whole. Therefore, vegans eat plants because it is consistent with compassion and fairness to do so. It would be uncompassionate and unfair, for example, to deliberately damage or destroy plants. But the fact is that plants give us a vast variety of fruits that can be eaten without being imprisoned or tortured, disrespected, killed, or separated from family and friends. These considerations make us realize that there are degrees of moral respect toward different forms of life. The degree of compassion that we have for a cow need not be the same as that we have for a mango. Therefore, a compassionate individual should avoid using animals and their by-products because exploiting animals causes them a great degree of suffering. By using their milk, eggs, or labor, we disrespect them. Animal by-products are typically obtained through practices that make them suffer or disrespect them. But in the case of plants, although they are living organisms, our using them does not require the same cruel practices that inflict pain upon animals.

## Conclusion

I want to conclude this discussion by once again pointing out that veganism, as I have defined it, is an expression of virtue. That is to say, veganism is the moral idea of avoiding using animal as a source of food, clothing, and more, whenever there are readily available alternatives. As I mentioned at the outset, my argument applies to those of us who have the fortune to live in affluent societies that enjoy an abundance of plant-based food and alternatives to wool, leather, and other animal-based by-products. Such circumstances, I believe, demand that we apply compassion and fairness to our relationship with animals. I am not suggesting that there are absolute rights and wrongs. The main characteristic of the virtuous person is that she does the best thing in a situation, all things considered. There are possible circumstances in which a virtuous character is compatible with using animals. Such circumstances might include, for example, a population that has no other means of sustenance but animals, or a lifeboat hypothetical, i.e., a situation in which a person or a group of people are stranded on a desert island with no food other than animals. Perhaps an important implication is that affluent societies applying VE should help less developed countries move toward veganism. For example, consider that some of these populations do have plant food, but do not use it. As Oppenlander (2013) notes in Food Choice and Sustainability,

> In Ethiopia, over 40 percent of the population is considered hungry or starving, yet the country has 50 million cattle (one of the largest herds in the world), as well as almost 50 million sheep and goats, and 35 million chickens, unnecessarily consuming the food, land and water…
> Much of their resource use must be focused on these cattle. Instead of using their food, water, topsoil, and massive amounts of land and energy to raise livestock, Ethiopia, for instance, could grow teff, an ancient and quite nutritious grain grown in that country for the past 20,000 to 30,000 years. Teff…is high in protein, with an excellent amino acid profile, is high in fiber and calcium, (1 cup of teff provides more calcium than a cup of milk), and is a rich source of boron, copper, phosphorus, zinc, and iron. Seventy percent of all Ethiopia's cattle are raised pastorally in the highlands of their country, where less than 100 pounds of meat and a few gallons of milk are produced per acre of land used. Researchers have found that teff can be grown in those same areas by the same farmers at a yield of 2,000 to 3,000 pounds per acre, with more sustainable growing techniques employed and no water irrigation — teff has been shown to grow well in water-stressed areas and it is pest resistant. (p. 175-178)

There are other regions of the world where inhabitants


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can import food staples, thus avoid relying on animals for food. An example often used is the Inuit, who inhabit the artic regions of Alaska, Canada, and Greenland. Not having fields suitable to grow food for all their meals, the Inuit traditionally ate only fish and seal meat. But nowadays, the Inuit live in communities with stores, schools, and modern buildings. Modern Inuit import food grown elsewhere and buy it in local stores. In fact, according to the Inuit Cultural Online Resource (n.d.), "Expensive food [is] bought at the local Co-op or Northern store, or shipped up from the south."

My contribution to the discussion of our moral responsibility toward animals is to provide a vision of a moral lifestyle, rather than a moral theory, that motivates us internally to become vegans. I proposed a view of morality according to which we acquire and develop important moral virtues, particularly the virtues of compassion and fairness, through paying attention to the lives of animals. Much work still needs to be done on the application of virtue/care ethics to eating with regard to our relationships with animals and with regard to the environment, public health and human rights. This paper is a starting point for the arduous work of defending ethical veganism. I have demonstrated how virtue ethics leads to ethical veganism. VE has much to say about how we apply attention, care, and virtue to animals' experiences of well-being, to recognizing that we are in a relationship with them and the only consistent moral response is veganism.

With regard to our treatment of animals, many virtues are important, though I propose that two in particular, compassion and fairness, enable us to see what is morally virtuous about veganism. Veganism is a worldview that wants us to realize that animals are not our property or our food; so, we should not use them in any way. Compassion and fairness show that an individual endowed with these two virtues thoroughly understands the suffering of animals and tries to alleviate their suffering. Our current behavior, i.e., eating animals and using their by-products, causes unnecessary pain to animals. One cannot be, for example, a compassionate racist or a fair rapist. As compassion is rooted in love, one who is truly compassionate will act out of love. There is nothing loving about racism or participating in the slaughtering and suffering of millions of animals. By the same token, one is not fair-minded if he is fair only to a restricted group of people or to his country, species, race, etc. Being fair means treating all equally. With regard to our treatment of non-human animals and our environment, a compassionate individual, by the very definition of compassion, desires to avoid pain because he is interested in others' well-being. Veganism, then, may be an expression of compassion. The compassionate individual refuses to take part in a practice centered on animal exploitation. Fairness also entails veganism, because the fair-minded behave in a way that is consistently just. It is unfair to treat certain animals with respect and not others, and it is unfair to turn animals into food for the sake of taste, tradition, or just because we can, when those animals do not wish to become food. Therefore, using animals as food, even if they are treated 'humanely,' is inconsistent with fairness and with compassion. Thus, virtue ethics can show us that veganism is a virtuous practice that should be embraced by most if not all people.

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**Conflict of Interests**

The author hereby declares that there are no conflicts of interests.

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# Habitus in alternative food practice: Exploring the role of cultural capital in two contrasting case studies in Glasgow

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alternative agri-food systems, alternative food networks, alternative food practice, cultural capital, food sovereignty, habitus

**Abstract**

This study is dedicated to the exploration of the role of Bourdieu's notion of cultural capital on the formation of habitus within alternative food initiatives (AFIs) among two contrasting case studies in the urban post-industrial landscape of Glasgow. This research will additionally demonstrate the role of cultural capital in the reproduction of inequality on a micro-level. Moreover, this investigation aims to point out, compare and contrast two distinct sets of habitus in those groups engaging in alternative food practice. A portion of the observed AFIs are situated in an area in proximity to the University of Glasgow in the West End of the city. The other community groups are located in an area with shipbuilding industry heritage, now dismantled, in Govan, in the south west of Glasgow. In both areas alternative food practices have developed substantially during the last decade. Via participant observation and in-depth interviews with a selection of individuals engaged in AFIs in the two areas, this study will juxtapose the cultural habitus of each community. This research explores to what extent, if at all, the subjectivities and practices in the two field sites differ from each other, whilst bearing in mind their starkly contrasting socio-economic contexts. The results indicate that the habitus at work in the West End is concerned rather with promoting healthy and sustainable life-styles, while the habitus in the Govan area is guided more towards the satisfaction of basic needs of existence. The findings also suggest that access to resources could be primarily dependent upon conforming to and adopting a bureaucratic mind-set.

## Introduction

During the past three decades there has been a notable interest in food systems analysis. Various research (Lappé, 1991; Weis, 2007; Roberts, 2008; Patel, 2009) indicates that the world food crisis is in fact a problem of the unequal distribution of an abundance of food, and is not, as is widely assumed, caused by an inadequate production of food. World hunger may thus not be caused by a lack of food but rather by the inability of hungry people to gain access to the world's abundance of food or food-producing resources, as they simply do not have the means to pay (Lappé, n.d., cited in Small, 2013). This suggests that in the contemporary world, mass poverty may be significantly related to the rising total global wealth of over 241 trillion USD as of 2013 (Selwyn, 2014). Mass poverty is thus not a consequence of the poor's exclusion to globalised production networks but rather their required subordination to the objectives of capital accumulation, which plays a key role in the reproduction of their poverty in order to sustain profitability in the first place (Selwyn, 2014). For instance, the latest dramatic increase in food prices in 2011 was an important factor sparking the subsequent social upheavals that came to be known as the Arab Spring. Furthermore, access is restricted not only by rising prices, but also by the tendency of the globalised system to create massive heaps of food waste (Gustavsson et al., 2011). Modern industrial

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food provisioning is also dominated by a minority of increasingly powerful corporations that are interested in gaining control over ever greater parts of the food chain (Patel, 2009). Its organisation into refined global production and distribution networks contributes to about 75% of the ecological destruction of soil, water, and biodiversity, and is responsible for 50% of the carbon emissions accelerating anthropogenic climate change (Lappé, 2010; Shiva, 2015). Conventional carbon-intensive food producing industries are moreover linked to health-related phenomena such as the growing obesity epidemic: for the first time in human history, the 800-900 million hungry are outnumbered by the one billion on this planet who are overweight or obese and, as such, are especially vulnerable to heart disease and diabetes (Patel, 2009).

The impact of the aforementioned global disparities and defects of industrial food networks on food-related subjectivities and experiences along the food chain in Scotland is the major concern and socio-cultural context of this paper. According to a health survey on obesity, "Scotland has one of the worst obesity records in the developed world, and one of the highest rates of all OECD and European countries. […] In 2010, 65% of adults aged 16 and over were overweight or obese" (The Scottish Government, 2011a, p. 6). At the other end of the scale, attention has been given to potential 'food deserts' (Cummins & MacIntyre, 2002). The issue has been discussed by nutrition and health researchers such as Cummins et al. (2005), whose study indicates a positive correlation between the level of neighbourhood deprivation and the likelihood of exposure to outlets from one global fast food company. MacDonald et al. (2007), in a similar vein, found evidence of a concentration effect that appears to link environmental risk factors for obesity with more deprived areas. There have been many more inquiries of this nature by the Scottish Government (2010; 2011a; 2011b; 2012); hence, it is not surprising that Scotland has been one of the first regions in the world to develop a national food and drink policy (2009). Further insights into food accessibility throughout Scotland are provided by the Food Standards Agency (2008). With regards to the aforementioned growing power and dominance of a minority of corporations in the business of food provisioning, a total of just over 8,000 supermarkets account for about 97% of total grocery sales in the United Kingdom (UK) (Small, 2013).

Since the Great Recession of 2008, the proclaimed austerity measures by the UK Government have pushed thousands of individuals and families to seek the help of food banks in order to meet their most basic needs for nourishment and well-being. In 2012 and 2013, the charity operating the UK's largest network of food banks, the Trussell Trust, helped a total of 14,318 people with its 42 outlets in Scotland alone (Duffy, 2014). While roughly one-third of edible food produced for human consumption, i.e. 1.3 billion tonnes annually, gets lost or wasted globally (Gustavsson et al., 2011), Scottish households throw away between 566,000 and 630,000 tonnes of food and drink every year which is equivalent to £1 billion, or £430 per household (Zero Waste Scotland, 2013; Love Food Hate Waste Scotland, 2014). This illustrates the peculiar interrelation of welfare and poverty: nearly all the world's hungry people could be provided with an adequate nutritious diet using less than a quarter of the food that is wasted in the United States (US), the UK and Europe combined (Stuart, 2009).

In light of the increased environmental stress caused by conventional food networks, more attention is being given to organic food and farming methods by the Scottish Government (2011b), who established the Climate Challenge Fund (CCF) in 2008, which supports more than 635 projects across Scotland to help "reduce carbon footprint and make community improvements" by granting them more than £54.7 million in funding (CCF, 2014). Around half of these projects have focused partly or wholly on food sustainability (Small, 2013). Scotland's most successful food-related project is the alternative food network (AFN) known as The Fife Diet. Established in 2007 and with over 5,000 members currently, this network published a dedicated and quick-witted new food manifesto (Fife Diet, 2012). The organisation plays an active role in promoting AFIs as part of policy developments in the Scottish Parliament in order to facilitate the dissemination of AFNs in the rest of Scotland.

In contextualising this study in this relatively broad field of modern food provisioning the attempt was made to point out major dysfunctionalities in the world food economy and to reflect upon the empirical state of affairs in Scotland. Alternative food practice is usually considered to develop in response to the shortcomings of the globalised food provisioning network as here outlined.

## Alternative food practice as a reaction to conventional food provisioning

The main literature dealing with alternative food practice is rooted in the analysis of social movements directed at establishing AFIs in relation to one another in a certain locality or region, which are commonly conceptualised as AFNs. In order to understand the emergence of AFNs, one first needs to locate the object of analysis in its historical, spatial and relational context. The relevant


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literature can be summarised as follows.

Drawing from reviews by Wilkinson (2006), Goodman (2003) and Murdoch (2000), Tregear (2011) proposes three main sets of perspectives. In the political economy perspective, AFNs are conceptualised on a macro-level as in a constant struggle opposing the threatening forces of economic globalisation, dealing with issues such as inequality, social injustice, and food insecurity (Allen et al., 1991; Allen, 1999; Allen et al., 2003; DuPuis & Goodman, 2005; Allen & Guthman, 2006; Abrahams, 2006; DuPuis et al., 2006; Allen & Sachs, 2007; Allen, 2008; Lima, 2008; Allen, 2010). Scholars of rural development and sociology appeal frequently to micro-level conceptualisations such as embeddedness, trust, quality and care (Murdoch et al., 2000; Ilbery & Kneafsey, 2000; Hinrichs, 2000; Sage, 2003; Renting et al., 2003; Winter, 2003; Kirwan, 2004; Kirwan, 2006; Watts et al., 2005; Sonnino & Marsden, 2006; Higgens et al., 2008; Morris & Kirwan, 2011) as well as "sustainable consumption" and "ecological citizenship" (Seyfang, 2006; Seyfang, 2008; Evans, 2011). Others in this strand have analysed the dynamics of AFNs in terms of shortening food supply chains and the repercussions for rural development (Ilbery et al., 2004; Ilbery & Maye, 2005; Ilbery & Maye, 2006; Maye & Ilbery, 2006). Finally, the modes of governance and network theory perspective contributes through its preoccupation with institutions and regulation at the meso-level, by explaining the reasons why seemingly similar actors, with similar goals and agendas, end up pursuing differing strategies (DuPuis & Block, 2008) or why some actors' agendas end up dominating others (Stassart & Jamar, 2008; Brunori & Rossi, 2007), providing fresh insights into familiar concepts such as trust, reciprocity and solidarity, which are co-produced and manipulated by contesting actors through vehicles of certification and regulation.

In the literature, considerable differences emerge between North American and European studies concerned with AFNs (Guthman, 2008). The former sees AFNs rather in oppositional and much more political terms, as in Allen et al.'s "oppositional activism" (2003), seemingly giving rise to a dichotomy between alternative and conventional food systems (Allen, 1999) and focused significantly on AFNs' capacity to wrest control from corporate agribusiness (Guthman, 2008). The latter is however entrenched in wide-ranging public debates on food safety (Guthman, 2008) and is concerned mainly with the potential of AFNs to contribute to the survival of rural businesses and the different processes of adding additional value to products (Marsden et al., 2000; Marsden et al., 2001; Marsden et al., 2002; Marsden & Smith, 2005). AFNs are rather seen as policy-driven, especially with regards to the EU Common Agriculture Policy (Goodman, 2004), and are considered useful means to "revitalise rural areas" (Sonnino & Marsden, 2006, p. 181). AFNs seem to emerge in accordance to conventional food systems, inhabiting niche markets for quality and more diverse products as farmers cannot solely support themselves by providing only to alternative distribution networks (Brown & Miller, 2008). An exception to this dichotomy is provided by Smeds (2015), who analysed two AFNs in Cluj-Napoca, Romania, that "contribute to a sustainable food paradigm by promoting agroecology, by reclaiming socio-cultural factors of food provisioning and by being part of a (re)-peasantisation process" (p. 48). Despite these overall contradictory views, it is, however, worth synthesising the main points of each sphere, so as to acknowledge AFNs as hybrid forms accommodating both more alternative, radical notions as well as more moderate, entrepreneurial types of organisations. However, there is a potential for "neoliberalization from the ground-up" (Allen & Guthman, 2006). It is thus worth paying "closer attention to the micro-politics that shape various initiatives" by being conscious of the trend of romanticising the "local as resistance" (Guthman, 2008, p. 1171). Rosol (2010) adds to this discussion by giving empirical evidence to the changing nature of the local state from adversely opposing public participation to its active encouragement, due to the continuing retreat from its traditional welfarist functions in order to cost-effectively outsource the maintenance of public green space by shifting the responsibility down to its volunteering citizens. Moreover this new outsourcing strategy of "neoliberal urban restructuring" aids the local authorities in saving maintenance costs and even simultaneously advancing the "beautification" and "ennobling" of its urban landscapes by transforming ugly, hazardous, neglected wastelands with the help of "unpaid labour of local residents" into aesthetically pleasing public green spaces (Rosol, 2012, p. 245). This development has been elsewhere analysed as a "municipal sustainability fix" (Temenos & McCann, 2012) or "austerity urbanism" (Tonkiss, 2013).

Holloway et al. (2007) propose a heuristic analytical framework in order to grasp the diversity and particularities in renegotiating the relations of power over how food production and consumption should be arranged in a society. This can range from "diffuse, often localised, struggles over modes of social ordering […] to more formal alliances between producers and consumers," in which both arenas of struggle deserve analytical attention, as "each has the ability to influence the other" (Goodman & Dupuis, 2002, p. 17). Despite attempts to devalue organic food consumption as a middle-class privilege and a practice of a "class diet," such "reflexive consumption" is nevertheless an expression of agency,

and should be seen as a new type of political action. Though this kind of "consumer activism" may never overturn the capitalist system, it does, however, "wield power to shape the food system" (Goodman & Dupuis, 2002, p. 13).

Recent critical accounts of this "consumption turn" in food system analysis argue that it is unlikely that "sustainable forms of consumption can be normalised and integrated into everyday lives" (Evans, 2011, p. 109). Such an analysis fails to include "those who are food insecure, and those without the necessary resources (time, labor, skill and expertise) to engage in local food provisioning" (McIntyre & Roneau, 2011, p. 1), pointing thus inexplicitly at the role of cultural capital in disguising underlying economic conditions. Goss (2004) also puts forth his skepticism and warns that "ethical consumerism" risks falling back into the trap of commodity fetishism by failing to recognise underlying causes such as alienating conditions of labour. Instead of celebrating alternative consumption, one should not lose sight of reaffirming the dialectical relationship between production and consumption (Goss, 2004). Bryant & Goodman (2003) moreover critique the underpinning "alternative" consumption practices in the commodity cultures so symptomatic of the Global North, which expresses itself eventually in a weakened form of social and political "caring at a distance," because of "an uncritical acceptance of consumption as the primary basis of action" (p. 344).

**Studying food (in)security in urban geographies within the core**

The last critiques outlined above led Abrahams (2006) to accuse scholars in the Global North and their theories of AFNs as too "Euro/Americo-centric," and stating that these scholars engage in exclusionary and elitist academic practices, as they tend to ignore the realities of AFNs emerging in the Global South. AFNs in the core (the Global North) exhibit a cultural habitus that is more consumerist and life-stylist – emphasising 'the right thing to do' – whereas in the periphery AFNs are much more survivalist by nature and culturally diverse (Abrahams, 2006). This is why AFNs developing in the south still remain outside the increasing terrain of conventional food systems, because the latter do not cater to the poor, who have less means to pay. Moreover, conventional food systems fail to offer foodstuffs produced by culturally sound means. In the Global South (the periphery) there exist two kinds of AFNs: the cultural and religious food networks as well as accessible food networks for the poor. This is in stark contrast to the northern AFNs, yet Abrahams (2006) points to the existence of food insecurity within the developed countries and proposes that it is increasingly necessary for alternative food studies to engage with the inequality of access to nutritious foods in areas of rural and urban poverty, which are increasing across the whole globe. That being so, food insecurity is also applicable to the post-industrial context within the urban area of Glasgow. That is why this study explores if and to what extent a diverging habitus can be observed within an urban geography of the global economy's core. Concretely, this investigation will examine Bourdieu's notion of habitus of groups engaging in alternative food practice in two contrasting case studies varying significantly in their socio-economic contextual settings. Thus, this study investigates the role of cultural capital in maintaining patterns of thought and action relevant in the reproduction of inequalities. This may prove a viable contribution to enhance understanding of the modes of sustaining inequalities under contemporary capitalism. The role of cultural capital in this case seems to be, as of yet, rather underdeveloped and underexplored. Since different social circumstances are likely to evoke different kinds of habitus (Bourdieu, 1979/1984), the cultural dimension in this respect is not to be underestimated.

This study articulates distinct modes of habitus operating in the developed core and towards the developing periphery. It will dissect how distinct dispositions, i.e. different levels and forms of capital resources, and processes of their application and utilisation function on a micro-level. Crucial for understanding the proposed argument is the concept of capital. Capital must be understood as accumulated reified labour time with an inherent claim to future resources. Bourdieu (1979/1984) was the first to extent the concept of capital beyond the economic sphere to include social, cultural and symbolic forms. Cultural capital includes thus not only an embodied state, but an objectified as well as institutionalised state (Bourdieu, 1986). The objectified form presents itself in material cultural goods (e.g., books, paintings, instruments) that can be consumed in two ways, materially presupposing economic capital and symbolically necessitating embodied cultural capital (Bourdieu, 1986). The institutionalised form denotes cultural capital to its bearer in an institutional, thereby official, recognition of its quality, as is the case with academic certifications. However, embodied cultural capital tends to function additionally as symbolic capital since it masquerades the social conditions in which it was transmitted and acquired, presenting itself as recognised and legitimate competence, dissipating "an effect of (mis)recognition" (Bourdieu, 1986). In the latter instance, it disguises the fact that not all agents and groups possess the means to prolong the length of time of the acquisition process, since not everyone is given the opportunity to be provided by one's kith and kin with the free time necessary, that is "time free from economic necessity," for the initial accumulation in the first place (Bourdieu, 1986).


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This study is also interested in the ways inequalities are maintained and how the likelihood of challenging them, wherefore one is led to introduce Bourdieu's other important concept of the habitus as a useful analytical tool to apply to this problem. The concept of habitus needs to be understood in relation to the social space individuals inhabit and the varying compositions and levels of capital that have been accumulated over time and are accessible to them. Habitus is a system of lasting and transposable dispositions: it is the practical, prereflexive and embodied, ongoing and active mode of being and acting according to one's social position in society (Swartz, 1997; Wacquant, 2008). Therefore, habitus sets structural constraints for action while at the same time encompassing opportunities for social agents who, by finding themselves situated within such a societal edifice, nevertheless have the capacity to evolve their perceptions, aspirations, and practices corresponsive to their formative socialisation in the past (Swartz, 1997).

## Methodological Framework

Regarding the progression of the research, methodology involved the collection of qualitative information via participant observation for around ten months between May 2013 and March 2014 in two neighbourhoods in relative proximity to each other, namely Govan and the West End, both within the City of Glasgow. This was complemented with twelve formally consented semi-structured interviews carried out in July and August 2013 (subsequently quoted as 1-12). An attempt was made to explore the motivations, challenges and objectives of those participating in AFIs, in order to be able to juxtapose these subjectivities in relation to their geographical and socio-economic contexts. A noteworthy ethical consideration is the recognition that this research may in itself be a contributing factor to the fostering of social inequality, as it was part of an educational degree that could potentially serve the social advancement of the researcher. This contradiction is therefore acknowledged and it was the aim of this research to expose such social tensions inherent in contemporary societies and their socially unique individuals.

## Discussion

### Contrasting AFIs in Govan with those in the West End of Glasgow

The socio-historical trajectories of the two field sites developed quite contrarily. While three AFIs emerged in an area in close proximity to the University of Glasgow in the West End, which distinguishes itself as an ethnically diverse neighbourhood known for its bohemian ambience and a high proliferation of students, the two other AFIs attempted to establish themselves in the district and former burgh of Govan situated south-west of the city and south of the river Clyde (**Figure 1**).

Govan is illustrative of the economic restructuring that has taken place in the UK during the latter decades of the 20th century. For most of its modern history Govan has been part of the industrial district of Clydeside shipbuilding. In 1950 the region produced around 20% of the world's ships (Foster, 2003). Govan's rise to become one of the world's prominent centres for shipbuilding was accompanied with a massive influx of Highland and Irish migrants, its population swelling from just over 2,000 in 1830 to over 92,000 by the year 1912 (McQuade, 2011). Nevertheless the reorganisation of the crisis-rid-

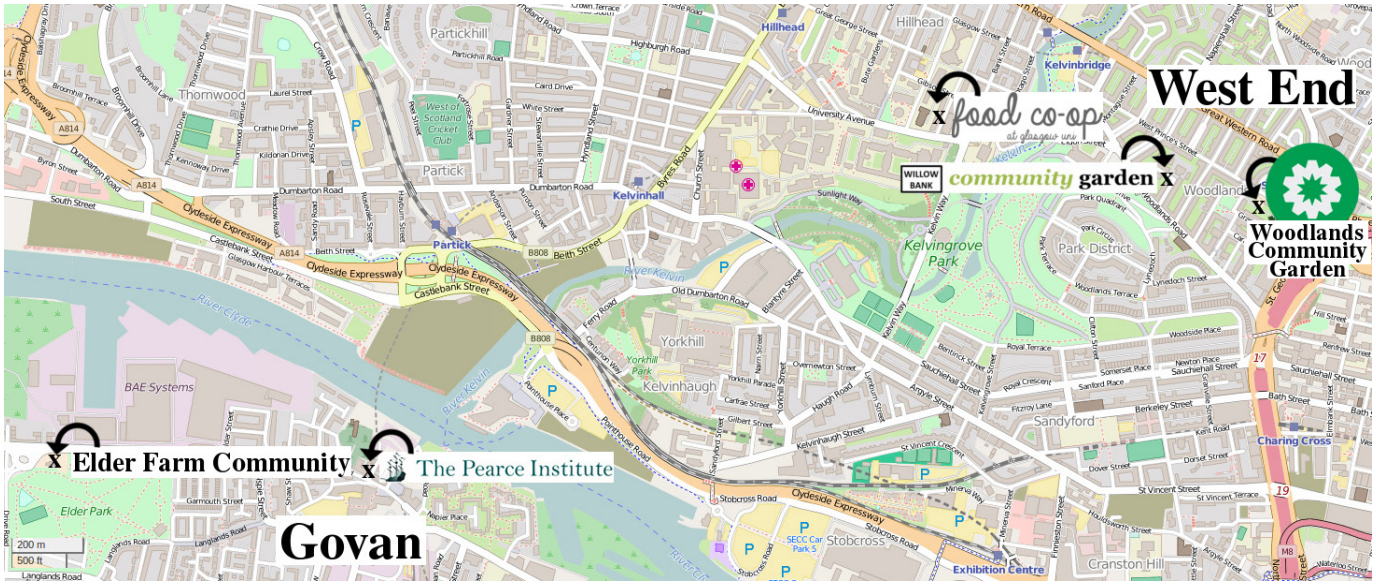


**Figure 1:** Location of the five investigated AFIs
Source: Map is adapted from openstreetmap.org; author's own depiction

**Table 1:** Juxtaposition of the five AFIs in the West End and Govan

| AFIs located in the West End | AFIs located in Govan |
|---|---|
| ***Woodlands Community Garden***<br>Location: West End (G4 9BY)<br>AFI est.: 2010 as a project by the Woodlands Community Development Trust (est. 1985)<br>Online presence: woodlandscommunitygarden.org.uk; twitter.com/wcdtgarden/<br>Funding: Scottish Government's CCF; Big Lottery, others<br>Organisation: 1 full-time and 6 part-time employees and 45-50 volunteers<br>Features: A third of its space is dedicated to raised beds allowing individual local residents to grow their own vegetables. The rest is shared by the local community with a meeting hub made from wooden pallets including an outdoor stage designed to accommodate social, cultural and environmental activities. | ***Elder Farm Community Garden***<br>Location: Elder Park in Govan (G51 4AA)<br>AFI est.: 2009 by local residents of Govan<br>Online presence: elderfarm.jimdo.com<br>Funding: none<br>Organisation: 10-30 volunteers<br>Features: Derilict space including a damaged old farm house. There is interest by the Elder Farm Community Group (made up of local residents) to revitalise the building since it causes public health and safety issues which the group must resolve before they are allowed to utilise the surrounding space. Despite the challenge to find ways to renovate the farm house, the surrounding area has been transformed into a lively community garden. |
| ***Willowbank Community Garden***<br>Location: West End (G3 6LF)<br>AFI est.: 2012 by students of Glasgow University<br>Online presence: guwillowbankgarden.blogspot.com<br>Funding: Student Representative Council (SRC)<br>Organisation: approx. 15 volunteers<br>Features: Fulfils first and foremost social and educational functions. | ***Govan Gatherings \| "Tuesday dinner nights"***<br>Location: Pearce Institute (P.I.) in Govan (G51 3UU)<br>AFI est.: 2011 as part of the 'Govan Together' project initiated by the Centre of Human Ecology (CHE)<br>Online presence: none<br>Funding: Scottish Government's CCF and participants<br>Organisation: 5-20 volunteers<br>Features: The project was initiated by CHE with CCF from Nov. 2011 until March 2012. With discontinuation of CCF, local residents decided to carry on even without funding. Weekly dinners remain self-sufficient through participants' donations. Part of its ethos is mutuality meaning that each member of the community learns to take responsibility for the project. A major issue since the end of 'Govan Together' is the acquisition of a regular meeting space within the P.I. |
| ***Glasgow University Food Co-op***<br>Location: West End (G12 8QQ)<br>AFI est.: 2011 by students of Glasgow University<br>Online presence: glasgowunifoodcoop.co.uk; facebook.com/groups/glasgowunifoodcoop/<br>Funding: Glasgow University and participating students<br>Organisation: approx. 15 key volunteers as "active" members, 35-45 "passive" members ordering food and up to 828 supporters in its Facebook group (as of October 2017)<br>Features: Aims to promote sustainable consumption of appropriately sourced organic food and house-hold items from a variety of ethically sound suppliers. Other functions include social events such as film nights, stalls, and pot lucks to promote its values and to extent outreach. | |

den post-war shipbuilding industry was not found worthy of British capital investment and the UK Government eventually declared the industry a relic of the past. A series of political and economic agendas then externally made Clydeside shipbuilding defunct, and in so doing ruined the entire industrial district of Clydeside. According to the Scottish Census (National Records of Scotland, 2011), the population of Govan (G51 postcode area) declined significantly to only around 21,500 in 2011. One in two Govanites is income deprived, which is double the Glasgow average (Govan Community Council, 2004).

There are hence key differences in the environments which the selected AFIs must navigate (**Table 1**). A major observation is that the West End projects were conceived of predominantly by students, and are preoccupied with the promotion of sustainable living. The AFIs in Govan, however, seem to bind a collective desire to socialise around weekly dinners and to seek some sense of self-determination in being able to eat self-grown food at local gardens. Alternative food practitioners in the West End face relatively different opportunities and constraints compared to their counterparts in the Govan area. The locally specific histories and memories of individuals in each of the settings have produced distinct


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dispositions they may or may not be aware of, but which are likely to result in certain distinguishable subjectivities, actions, strategies and behaviours.

The next section will attempt to show in what ways a distinct habitus in each of the field sites can be acknowledged in relation to the nature of activities the participants are engaged in, their take on open public space, and their position to funding with regards to the organisational structures effectively in place and their associated ramifications.

**Results and Analysis: Exploring habitus and the role of cultural Capital in the two field sites**

To begin with, it should be noted that all AFIs in both localities function as "places of prosumption" (Shaw et al., 2016) and generally aim for the same outcomes: to advance their neighbourhood in terms of extending the degree of sustainable self-sufficiency, food sovereignty and awareness of the environment. Yet there is unequal emphasis on each of these goals. **Table 2** provides an overview of the composition of cultural capital by juxtaposing the varying modes of habitus within AFIs active in the West End and Govan.

**The nature of activities**

In the West End, one interviewee stressed their satisfaction with working outside and producing and eating one's own food (7.1). This seems to suggest that the involvement in a community garden is a conscious choice, an alternative to sourcing food from rather unaccountable supermarkets, which is nevertheless "satisfying" and even "empowering." It may, moreover, be simply a well-reflected lifestyle choice. These narratives emerge frequently in the data set, especially in the West End. In Govan the motivations for being involved in such projects stem predominantly from the need to be more cautious with one's everyday expenses and overall living costs (2.1 and 5.1). Gardening tends thus to be experienced as "a good kind of therapy" (4.1). What is more concerning is the fact that this widespread structural employment deficit as touched upon in the previous section, carries other serious implications such as higher than average experiences of premature death (5.2). In fact, during the author's own involvement in the area of Govan for three years, the author has personally known, or was told of, three individuals passing away before the age of fifty. Each of them had been very friendly and active members or participants of various community projects in the neighbourhood. Such sudden losses characterise the social reality and life experience of fellow members of the Govan community. Premature deaths are not uncommon in Scotland as a whole whose excess mortality patterns seem to resemble those witnessed in Eastern Europe (McCartney et al., 2011).

These immediate experiences of regular demise seem more or less absent in the West End. However, these events and broader developments do not remain unnoticed. For example, Woodlands Community Garden applied for funding provided by the Big Lottery for more marginalised groups from 2013 until the middle of 2015 (10.1). One function of cultural capital exemplified here is a certain reflexive self-awareness of one's position of privilege, which may be compensated by what Bourdieu (1979/1984) described as performing "cultural goodwill" (p. 318). This can be witnessed when an interviewee expressed concerns with regards to the UK Government's move towards food banks in order to discipline job seekers for inadequate compliance with its rules and means tests (12.1). In speaking for the less well-off and by kick-starting projects to ideally counteract such a "draconian system of sanctions," (12.2) participants may experience the activity of providing relief to the poor as a way to feel better about themselves and to subconsciously legitimise their own status by ignoring their own role in the very system that creates poverty in the first place. It also illustrates the hidden circumstances that made the performance of cultural capital possible. Participants in the West End are able to devote their time to charitable projects mainly deriving from their position of privilege in the social space and enabled by their "distance from necessity" (Bourdieu, 1979/1984). Yet this cultural goodwill seems not to identify with acts of vandalism which are subject to much condemnation (7.2). The element of classism shining through elucidates the misrecognition of the symbolic power of the effects of cultural capital. In Govan, by contrast, the issue of vandalism gets treated less sensationally, as illustrated by statements as "kids burn things down all the time" (4.2) or "if you draw on the vandalism […] you'd be defeated immediately […] but, well, you just go and have a rest for a couple of days and then come back vital and feel stronger" (5.3 and 2.2). Broadly speaking, two subjectivities seem to resemble the composition of cultural capital in each area. Whereas the individuals active in the West End legitimise their engagement in alternative food practice based on ethically well-reflected idealist principles, as well as having the necessary time at hand to engage in philosophising about the right way to live one's life, their counterparts based around Govan are guided more or less solely by practical imperatives that allow for a small positive advancement of their own situation. As shown previously, Govanites have completely different access to economic as well as cultural resources. They are more troubled with getting by in everyday life. There seems to be also more of an understanding of troublesome kids. They seem to be more used to experiences of failure and loss, of not fitting into a society based on merit.

**Table 2:** Juxtaposing modes of habitus and the composition of cultural capital within AFIs in the West End and Govan

| West End | Govan |
|---|---|
| **Nature of activities** | |
| • conscious, well-reflected lifestyle choice<br>• reflexive self-awareness of position of privilege: performance of "cultural goodwill" (Bourdieu, 1979/1984)<br>• classism as misrecognition of symbolic power of effects of cultural capital | • need to be cautious with everyday expenses<br>• higher than average experience of multiple deprivation and premature death<br>• gardening as a kind of therapy<br>• better understanding of troublesome children |
| **Relation to open public space** | |
| • involvement in community gardens offers variety to everyday-life and raises awareness | • appreciation of freely accessible, non-commercial space |
| **Position to funding** | |
| • more attuned to adopting a bureaucratic mind-set despite awareness of the tediousness of funding processes: benefits of financial support<br>• economic security through ownership makes possible the dissemination of cultural capital<br>• AFIs more prone to time-inconsistency due to fluctuation of students' commitment | • critical attitude towards funding due to past collective experience of urban regeneration/community development strategies<br>• `do it ourselves' attitude and habitus of the more practical kind guided by "choice of the necessary" (Bourdieu, 1979/1984)<br>• interested in skill and wage transfers into area |

**Relation to open public space**

A further regularly emerging theme worth discussing is that of open public space. Respondents in Govan often highlighted the importance of spaces that are accessible to anyone (8a.1). It seems very important to be able to go to spaces that are non-commercial and freely accessible, just as most community gardens aspire to be. Yet the irony is that the community garden in Govan is only open to the public as long as one key holder is present in the garden itself. But as the same interviewee went on to say, the reward of gaining access to such spaces may be achieved mainly through commitment (8a.2).

Certain individuals in Govan are aware that "there's a lot of community centers now where you are having to pay commercial rents and people don't like what you do in them, and what you don't do and what you can do, and what time you can do in different things like that," so at the end of the day, "open space is never gonna be bad investment" (4.3). Conversely, the West Enders perceive open public spaces as places offering a certain variety to everyday life that can also be used to raise awareness of environmental issues (7.3 and 10.2). The non-commercial aspect was completely absent in all interviews with participants engaged in the West End area, so seems to be not as important as it is south of the Clyde in Govan, for instance. However, one West End interviewee stressed the joy of "growing stuff, and seeing familiar people" and stated that "it is a really nice space in the city, which I feel a degree of ownership over" (11.3), reflecting a more sensitised point of view on the benefits of an "active sense of place" that allow for individual and collective empowerment as community gardens "become generative spaces for creating more collective and solidaristic forms of work" and "foster new collective and egalitarian ways of working with food" (Cumbers et al., 2017). At this point, it makes sense to mention once again that two community gardens in the West End are open at all times to the public. The AFIs in Govan are struggling to make their space regularly accessible, but are also confronted with rather different circumstances, as they needed to negotiate the sensible use of the right spaces for holding their community dinners in the P.I., for instance. This leads to the final point of this discussion: the ways of organising AFIs and their position in relation to funding.

**Position to funding**

Willowbank Community Garden and the Glasgow University Food Co-op were initially started by the passionate work of student volunteers and received little to no funding at all. Woodlands Community Garden, however, was successful in allocating funds from the CCF and was so able to pay a small team of part-time workers organising the development of the garden itself. It seems


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relevant to highlight the specific role the acquisition of cultural capital plays with regards to managing funds. The participants of Woodlands Community Garden are more attuned to the bureaucratic work that it entails, but are also keen to justify the benefits financial support can bring (10.3).

The acquisition of cultural capital finds its immediate expression and conversion into economic rewards through the ability to adopt a bureaucratic mindset. In this example, it also presupposes that Woodlands Community Garden, i.e. the Woodlands Community Development Trust, actually owns the space it resides on. The economic security of ownership makes it possible for this AFI to develop and disseminate cultural capital with hindsight. Additionally, the sense of ownership may root in the fact that there have been organisational changes that were themselves the outcome of persistent struggle over decision-making processes, for instance (10.4). With funding comes, more often than not, a set of restrictions and obligations, which again limit the freedom of AFIs as they need to comply with certain targets set by the funder (7.4).

The other two AFIs, which are mostly student-driven, are characterised by a general fragility and fluctuation of students' commitment (11.2). The aim of the food co-op is therefore to do some justice to its aspiration of continuity by being based in the SRC in order to get "as many people as possible involved" (11.3). Three years onwards, the Food Co-op experiences actual difficulties in maintaining its organisation exemplified by the fact that it no longer has a running bank account to accept further orders.

A more critical or at least skeptical attitude towards the issue of funding is persistent in Govan's case, most likely due to their collective experience with the urban regeneration/community development strategies employed by the Glasgow City Council (Feeney & Collins, 2015). A common response within the community is to 'do it ourselves' or similar ethos such as "problems in the community can be fixed by the community" (4.4). The DIY attitude within the dinners group particularly "appealed" to one group member (8b.3). The aforementioned vulnerability of alternative food practices to neoliberal cooptation is contrasted here with the opening up of "other socio-political subjectivities", i.e. the formation of "DIY citizenship" as an "effective political practice" (Crossan et al., 2016). Such openings in AFN practices have also been conceptualised as supporting "a politics of the possible" (Harris, 2008).

The lack of sound organisational structure in Govanite AFIs may remind one of the habitus of the more practical kind (8a.4). The structure superimposed on people's lives, dominated by the disciplinary measures applied to them only to get their basic means of sustenance, may indeed lead those with low incomes to cultivate a habitus more antagonistic to the more complicit groups of society, those who implicitly seem to be able to live quite comfortably despite subjecting themselves to the more bureaucratically governed spheres of life. As previously discussed, such subjection implicates moreover to collude in the advancing processes of "beautification" of urban landscapes (Rosol, 2012) so as to heighten their perceived value for global place marketing, including "trajectories of displacement, transformation, commodification, resistance, or, disappearance" (Colomb, 2012, p. 131).

This is not to say that the Govanites never discussed funding possibilities. They are, in some way, practically predisposed to getting things done without having to care about the rigmarole of filling in funding applications and the like (and all that this entails), which may be framed under a habitus guided towards the "choice of the necessary" (Bourdieu, 1979/1984, p. 372). There are tensions within the community regarding this issue, and it seems that, for example, in order to transform Elder Park farm house back into a usable building and community space, the group moves towards the direction of attempting to guarantee funding under the condition that local residents have opportunities to be trained in the crafts necessary to regenerate the building. The overall aim seems to be to direct skill and wage transfers back into the area in order to genuinely regenerate the Govan economy. With every second person left unemployed, the potential to re-empower the area is enormous.

## Conclusions and Recommendations

This paper sought to investigate the impact of habitus on alternative food practice and, in particular, intended to highlight the significance of cultural capital in reproducing inequalities of access and development in AFIs. The main hypothesis is that macroeconomic contradictions of the world food system express themselves also on the micro- or regional level. There are at least two very contrasting practices within AFNs in the more affluent core and the less affluent periphery within the world food system. Whereas alternative food practice in the core is primarily centered around challenging the more dominant actors in the food system, the periphery is primarily concerned with accessing, first and foremost, their culture-bound means to basic sustenance. The core accepts particular logics of legitimation that are rather in contrast to its more peripheral counterpart. The former

may be rooted in either a more radicalised life-stylist or a more modest consumerist mode of rationalisation, but still finds itself in a privileged position of choice. The latter's rationale, however, is concentrated around the few possible and still rather limited choices that are available, revealing more culturally diverse and survivalist approaches.

The concern of this research has been to exemplify two parallel collective subjectivities emerging within cities of the world system's core. It is no coincidence that these macro-scale developments can be observed and are indeed reflected in the numerous microcosms that produce these systemic contradictions in their everyday practice. Within the boundaries of Glasgow there are significant differences in quality of life. The two selected field sites of the more affluent West End, and the rather income-deprived area of Govan have provided this study with the necessary background to enable investigation as to whether there truly are two kinds of habitus presenting themselves in the respective communities.

This study has been conducted under the assumption that the differing socio-historical contexts the members of the two communities inherit should result in distinguishable formations of habitus, i.e. diverging motivations, approaches and strategies being pursued to overcome their community-specific challenges and obstacles to satisfy their diverse needs and desired objectives.

The habitus of participants active in the West End's AFIs tends to array towards a bourgeois idyll of urban living (often sybaritic would be more apt), resulting in their relative distance from necessity and preoccupation with education and raising awareness of environmental issues. The volume of their cultural capital additionally marks a certain level of self-awareness of their role in relation to other less-privileged groups, which can manifest itself in a feeling of uneasiness, and a realisation of privilege that may have hitherto been unchallenged. This can result in a defensive, cynical distance or reserve, which seems to be compensated by engaging with the latter in projects of poor relief, doing justice to their "cultural goodwill" (Bourdieu, 1979/1984). Their relation to open space is experienced in a more aesthetic way, being outdoors, in wild places. Although there are signs of wariness towards the bureaucratic apparatus, the AFIs do succeed rather readily in securing external sources of funding, demonstrating their natural, docile dispositions and endowment with the necessary cultural capital to cooperate with systematic rules and regulations.
However those engaged in AFIs in Govan express a more practical habitus oriented towards the "choice of the necessary" (Bourdieu, 1979/1984). Their main preoccupation is finding meaningful ways to escape the effects of the continuous humiliation of long-term income-deprivation. Periods of existential crises are momentarily dismissed while experiencing therapeutic benefits from alternative food practices, by socialising in food growing projects or weekly dinners. Concerning their encounter with open public space, individuals value predominantly the non-commercial aspect, of being able to associate with others on freely accessible lands. It might appear that, whereas the AFIs in the West End seem rather more consensual and conformist in their practice, predisposed to be docile and more readily adopting a bureaucratic mind-set, those in Govan tend to be slightly conflictual with each other regarding funding issues and are naturally much more suspicious towards outsiders, be it City Council officials or funded community workers, due to an influential and lively memory of past encounters.

This study has thereby demonstrated the existence of such differing modes of habitus in relatively close urban geographies. These sets of dispositions nevertheless translate into wider social distance with regards to the actual position of each in the social space differentiated not only in economic but, at least equally importantly, in cultural terms.

Last but not least, this paper will point out recommendations for future research. At the beginning of this project, the intention was to explore the evolution of the Glasgow Local Food Network. It would seem worthwhile to undertake such a future investigation with regards to its internal interconnectivity, as well as its encounters of (re)negotiating land use with the Glasgow City Council, for instance, in order to increase the designated green area available for and conducive to setting up new food growing initiatives. Another task would be the development of a food map, gathering the amounts and types of food outlets and AFIs per area per inhabitant, thus allowing empirical judgements about the diversity and general nature of food accessibility in Glasgow. This could be complemented with quantitative survey-based research to correspond socio-economic status with the private food habits of its residents. Finally, an investigation of potentially differing habits with regards to the handling of food waste within close urban geographies is recommended.

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The author hereby declares that there is no conflict of interests.

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# Household food security: Trends and determinants in mountainous districts of Nepal

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**Abstract**

This paper assesses household food security and identifies the factors affecting it in two mountainous districts of Nepal using census data from 2011/12. A binary logit model has been used because the dependent variable is dichotomous. In the study districts, farmland expansion was the major contributor to the increased production of major crops over the period 1974/75 to 2013/14. The yield growth of major crops, with the exception of potato and wheat, remained below the population growth in these districts. On average, households experienced no food shortages for about 9 months out of the year; cultivated land per household was 0.63 ha, of which around 29% was irrigated; 22% of the households were female headed; and 60% of the households worked in allied activities alongside agriculture. The results show that household food security was positively affected by the following variables: male-headed household, household members with both agricultural and allied occupation, age of the household head, percentage of irrigated area, number of livestock owned by the household, and owner operator. Household food security was negatively affected by the variables household size and time taken to reach the nearest market. Taplejung district's food security was better than that of the Bajura district. The findings imply that female-headed households need support in order to improve their food security. There is a need for on-farm value-added processing and off-farm employment opportunities, which could be provisioned by financial support and development of the required technical and managerial skills. Public investment should be increased in markets, roads and irrigation infrastructure development in rural areas. Moreover, improving access to land and its utilization based on comparative advantage could improve household food security.

## Introduction

Food security is an important issue for both the developed and developing countries. However, the situation in developing countries is more severe. Out of 795 million people suffering from hunger, 780 million live in developing countries (Food and Agriculture Organization (FAO), 2015). Compared to other regions, the progress towards reducing the number of hungry and malnourished people has been slow in South Asia and sub-Saharan Africa, despite many success stories at country and sub-regional levels. The highest burden of hunger occurs in South Asia, where as many as 281 million people are undernourished (FAO, 2015).

Land is an important factor for food production. Among the South Asian countries, the ratio of agricultural land to total land is lowest in Bhutan (13.8%), whereas this ratio is highest in Bangladesh (69.9%). The ratio for Nepal is 28.7% (World Bank, 2017). Food availability in Nepal is aggravated by a myriad of complex issues, including, but not limited to, waning agricultural production rates, rising population pressure, declining soil quality, and the mountainous terrain. The increasing demand for food

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has to be fulfilled from the same amount of agricultural land, yet a growing number of studies from Nepal suggest that, in some areas, more than 30% of total cultivated land has been abandoned (Khanal & Watanabe, 2006).

Hunger and malnutrition are pervasive across Nepal and affect certain groups of people and households more than others. Within a physiographic region, some communities are more food insecure because of their social and/or economic status. Households are said to be food secure if their entitlements or demand for food is greater than or equal to their household needs (Pant, 2012). Sen developed the entitlement theory in order to provide a more convincing answer to household level food insecurity. Entitlements are the set of alternative commodity bundles that a person can command in a society using the totality of rights and opportunities that he or she faces (Sen, 1981). The production-based entitlements among households are affected by land endowments. Moreover, the people residing in remote areas, such as mountains and hills, and those without gainful employment suffer more from household-level food insecurity. Risk of food insecurity is also increased for those who rely on subsistence agriculture with limited off-farm income and those who depend on the market for food due to market imperfections and escalated prices for consumers (Pant, 2012).

Much of the food security-related literature on Nepal is based on qualitative and descriptive analysis and is mostly concentrated at the national and regional level. This shows the necessity of a study regarding food security at the household level based on empirical analysis. Understanding the issue from a micro perspective would be important in dealing more effectively with the problem of food security and consumption. Therefore, this paper aims to analyze the production and productivity of major crops, assess the edible food grain production and requirements, and identify the factors affecting household food security in two mountainous districts of Nepal.

## Literature Review

Food security as a concept originated only in the mid-1970s during discussions about international food problems at a time of global food crisis. Since its introduction, the academic community and political sphere has evolved, developed, and diversified this concept (Giraldo, Betancur, & Arango, 2008). The International Fund for Agricultural Development (IFAD, 1999) defines Household Food Security as "the capacity of households to procure a stable and sustainable basket of adequate food". A comprehensive definition was given by the Rome Declaration on World Food Security (FAO, 1996): "Food security exists when all people at all times have physical and economic access to sufficient, safe, and nutritious food, which meets their dietary needs and food preferences for an active and healthy life."

The Rome Declaration also pledged political will and a common and national commitment to achieving food security for all and to an ongoing effort to eradicate hunger in all countries, with an immediate goal of reducing the number of both impoverished people and undernourished people to half their 1990 level by no later than 2015. In this regard, Nepal met the target of halving absolute poverty and will soon halve the proportion of people who suffer from hunger. The Millennium Development Goal (MDG) target of reducing the prevalence of underweight children aged 6-59 months was achieved. For example, the proportion of stunted children decreased to 37.4% by 2014, surpassing the target of a 30% decrease (National Planning Commission (NPC), 2015).

Access to an adequate supply of food is the most basic human need and right. There are four main dimensions of food security: food availability, access, utilization, and stability (FAO, 2008). Food availability at the national level, food access to households, and its utilization by individuals are the core aspects of food security. In general, the determinants of food security are different at different levels of application, i.e., global, national, regional, household and individual levels (Khan, Azid & Toseef, 2012).

Several studies have been carried out to identify the determinants of food security in various contexts and levels using different variables and methodologies. Some studies have focused on household characteristics, such as size and structure; gender, educational attainment and age of the household head; or household preferences and tastes as the main drivers of food insecurity (Kidane, Alemu, & Kundlhande, 2005; Kabbani & Wehelie, 2005; Iram & Butt, 2004), while others looked at economic factors, such as income and consumption patterns, or food and input prices (Makombe, Lewin, & Fisher, 2010; Onianwa & Wheellock, 2006). Other studies have found issues of land size and productivity, fertilizer application, ownership of cattle and production of grains to be key (Khan & Gill, 2009; Kidane, Alemu, & Kundlhande, 2005). Additionally, access to markets, land, and water; production and marketing infrastructure, and also availability of services such as extension were variables identified as vital to food security (Misselhorn, 2004; Makombe, Lewin, & Fisher, 2010).

Tefera and Tefera (2014), using a logistic regression model in Ethiopia, found that the age of household head, level of education, household size, size of cultivated land,

use of improved seed, number of contacts with development agents, size of credit received, size of livestock owned, and off-farm income all significantly affected food security. Similarly, using logistic regression in Nepal, Maharjan and Joshi (2011) revealed that any program targeting occupational castes, small landholders or the landless and the provision of employment opportunities for the economically active age group would contribute significantly to reduce food insecurity. In this case the probability of being food insecure rose with an increase in family size, while an increase in irrigation availability contributed significantly to reducing food insecurity. Additionally, a significant proportion of male-headed households and households residing in Terai were found to be food secure.

Bashir, Schilizzi, and Pandit (2013) examined the regional sensitivity of rural household food security in three regions of Pakistan using logistic regression. The results revealed that livestock assets had a positive impact on food security across all three regions, while family size had a negative impact. Intermediate and graduation levels of education improved food security in Northern and Central regions, respectively. In the Northern region, total number of income earners in the household also positively impacted food security, while age of the head of household had an inverse relationship with food security. The results imply that targeted, region-specific policies are needed to improve food security in Punjab.
A logistic regression analysis in Bangladesh by Ali, Noor, and Alam (2016) revealed that, for the head of household, age, income, and the level of education positively and significantly influenced household food security, while the number of dependents (i.e., household size) influenced food security negatively.

The impact of climate change on food security differs by gender and economic class. The dependence of women on subsistence farming is relatively high in Nepal. With increasing migration of young men away from rural areas of Nepal, the farming system is highly feminized; the agricultural labor inputs of women are very high. Therefore, rising temperatures, unpredictable precipitation patterns, and an increase in extreme-weather events will have a disproportionate impact on women who depend on subsistence farming for their livelihoods (Adhikari, 2014). Pokhrel and Pandey (2011) mentioned that in Nepal, decreasing availability of food is likely due to climate-induced reduction in crop productivity, decreasing availability of agricultural water or inefficiency of conventional irrigation systems, poor availability of quality inputs/breeds, under-utilization of available technologies, the cereal-based food habit, agricultural land depletion and degradation and, on account of these factors, possible occupational shifts, migration and resultant land fallowing.

In Nepal, the abandonment of farmland is due to low returns, which encourages people to migrate to non-farm jobs, especially to foreign labor markets, causing further shortages of labor and high wages (Adhikari & Hobley, 2012). Every day, about 1,500 to 1,700 Nepali youths, mainly male, migrate to the Gulf States, Malaysia and India for work (Adhikari, 2014).

As per the Ministry of Agricultural Development (MOAD, 2012), households in the Far Western Hill area experience food consumption gaps and high or above-average acute malnutrition, or meet minimal food needs only with accelerated depletion of livelihood assets. For these reasons, this area is categorized as chronically food insecure (Integrated Food Security Phase Classification - IPC Level III). On average, the annual food production in the area covers the needs for only nine months of each year, the production of wheat and maize has been decreasing over the past five years, the performance of nutrition and health-related indicators are extremely low, and the region is classified as being highly vulnerable to natural disasters, including drought, floods and landslides. On the other hand, households in the Eastern Mountain area meet their minimal food needs with traditional coping strategies, but are unable to afford some essential non-food expenditures without engaging in irreversible coping strategies. Hence, they fall under chronic food insecurity at IPC Level II. The indicator data for food access, nutrition, vulnerability and utilization shows some sign of food insecurity, although there is no substantial problem of food availability and stability.

The average landholding size in Nepal declined from 1.13 ha in 1981 to 0.80 ha in 2001 and 0.68 ha in 2011 as per Central Bureau of Statistics (CBS, 2003; CBS, 2014). The size of landholding and food self-sufficiency has a positive correlation. Only about 6% of the households with less than 0.1 ha are food self-sufficient from their own production, while 63% with holdings above 0.5 hectare are self-sufficient (CBS, 2013). As of 2015, Nepal ranked 58th among 104 countries in terms of the Global Hunger Index (GHI). The score improved from 44.5 in 1990 to 31.6 in 2005, and to 22.2 in 2015 (von Grebmer, 2015).

## Materials and Methods

### Description of the Study Districts

Bajura is a mountain district in the far-western development region, covering an area of 2,188 km$^2$. Martadi, the district headquarters, lies at a distance of 950 kilometers from Kathmandu. The elevation of the district varies from 300 m to 6,400 m above sea level (masl), which


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**Figure 1:** The Study Districts in Nepal, Source: Author

divides the district into three distinct regions from north to south: higher Himalayan, higher mountains and mid mountains. This results in a variation in temperature, which ranges from 0°C during winter to 40°C during summer. The annual average rainfall is 1,343 mm, which decreased at a rate of 18.25 mm/year over the period 1976-2011. In addition, the inter-annual variation of rainfall is pronounced over the same period. The combined climate change vulnerability index for Bajura is moderate; however, it is highly vulnerable for drought and moderately vulnerable for landslide. In addition, ecologically, this district is highly sensitive to climate change (Sherpa et al., 2015). The average population density is around 62 people per square km, with a family size of 5.4. The average land holding is 0.42 ha and almost 76% of the agricultural land is non-irrigated (CBS, 2013). The map of Nepal showing the study districts is presented in **Figure 1**.

Taplejung is a mountain district in the eastern development region, covering an area of 3,646 km$^2$. Phungling, its district headquarters, lies at a distance of 674 kilometers from Kathmandu. The elevation ranges from 777 to 8,598 masl. The average annual temperature is 11.3°C (0°C during winter and 30°C during summer). The annual average rainfall is 1,440 mm, which decreased at a rate of 5.6 mm/year over the period 1975-2009. This district is vulnerable to rainfall and temperature-related extreme events. The average annual maximum and minimum temperature have increased over the period from 1981 to 2010. The combined vulnerability index is moderate, which may be linked with low socio-economic status as well as inadequate roads and market infrastructure (Sherpa et al., 2015). The average population density is around 35 people per square km, with a family size of 4.8. The average land holding is 0.95 ha and about 73% of the agricultural land is non-irrigated (CBS, 2013).

## Data Sources

The latest agricultural census data (2011/12) collected by the Central Bureau of Statistics (CBS) was used for this study. Two districts from mountainous regions, one each from the eastern (Taplejung) and far western (Bajura) regions, were purposely selected. The basic sampling methodology was a two-stage area sampling, as follows: in the first stage, selection was based on a stratified sample of enumeration areas (EAs) with probability proportional to the expected number of agricultural holdings (stratified PPS sampling); in the second stage, within selected EAs, a selection was made of a sample agricultural holding using stratified systematic random sampling. The EAs were defined as wards (the smallest administrative and political units). They contained less than 25 holdings or possibly more than 25 but less than or equal to 30 holdings if wards were combined. As a result, between 20 and 30 holdings were selected in each selected EA (CBS, 2013). For this study, 18 EAs from Taplejung with a total of 430 holdings, and 19 EAs from Bajura with a total of 451 holdings were selected, with a total sample size of 881 holdings.

## Analytical Framework

Food security is multidimensional and involves complex realities, processes, and linkages. The Food Insecurity and

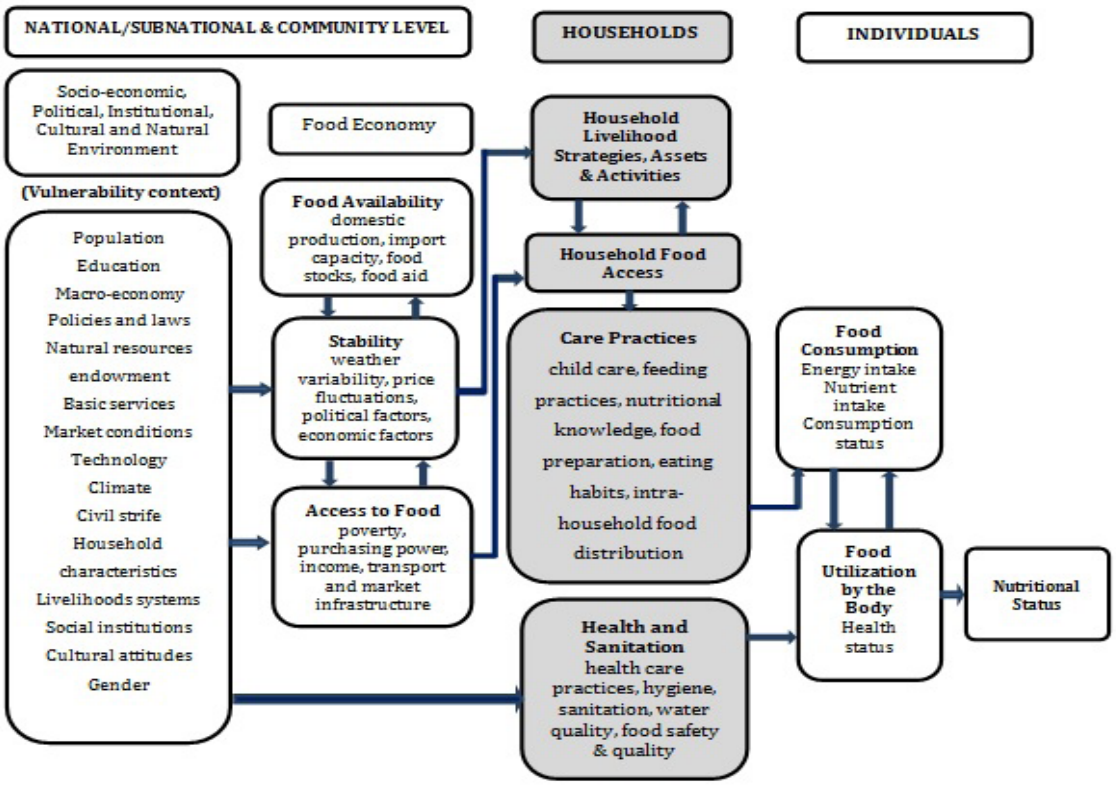


**Figure 2:** FIVIMS nutrition framework: linkages between the overall development context, the food economy, households and individual measures of wellbeing, Source: FAO, 2008

Vulnerability Information and Mapping System (FIVIMS) framework developed by FAO (2008) has been used in order to understand linkages among various food security dimensions and to explain linkages with underlying causes and outcomes (**Figure 2**). This framework highlights the need to consider underlying socio-economic, political, institutional, cultural and natural factors, as they impact different dimensions of food security (i.e., food availability, access, stability, and utilization), while also affecting care practices, in addition to conditions related to health and sanitation. These dimensions interact in a sequential manner, i.e., food must be available, then households must have access to it, then they must utilize it appropriately, and then the whole system must be stable (Barrett, 2010).

Food availability is determined by the level of domestic production, the capacity to import and receive food, the ability to maintain stocks and reserves, and the functioning of markets. Food consumption at the household level is affected by access to food and child care. Food access is determined by relative poverty/incomes, purchasing power, income transfers, quality of transport, and market infrastructure. Factors such as intra-household food allocation, cultural practices, and knowledge related to food preparation affect the level of child care. Efficient and effective food utilization by the human body is understood to be primarily dependent on a person's health status, which in turn is dependent on general health and sanitation. The nutritional outcome is understood to be dependent on food consumption (food intake in terms of energy and nutrients) and the biological utilization of this food (determined by a person's health status). If the dimensions of availability, access and utilization are sufficiently met such that households have adequate quality and quantity of food, the next question is whether or not the whole system is stable, thus ensuring that households are food-secure at all times. Climatic, economic, social and political factors can all be sources of instability.

## Analytical Method

Many socio-economic and demographic features of farm households affect food security and food availability. Binary logit or probit models are employed when the number of choices available is limited to two. In this study, a binary logistic regression model has been used to examine the factors influencing household-level food security. The distribution functions are bounded between 0 and 1. The model is based on the cumulative logistic probability function. It uses logistic CDF and is specified as (Pyndick & Rubinfeld, 1991):

$$P_{1/i} = F(\alpha + \beta Xi)\frac{1}{1+e^{-(\alpha+\beta Xi)}} = \frac{e^{(\alpha+\beta Xi)}}{1+e^{(\alpha+\beta Xi)}} \quad (1)$$


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**Table 1:** Average calorie consumption in Nepal, Source: NPC (2013)

| Population | Average kilocalories consumed per capita per day | Percent of the population with food energy deficient |
|---|---|---|
| **Nepal** | **2,536** | **38** |
| Urban | 2,525 | 43 |
| Rural | 2,539 | 37 |
| **Regions** | | |
| Mountains | 2,403 | 45 |
| Urban - Kathmandu | 2,481 | 53 |
| Urban - Hill | 2,524 | 42 |
| Rural Hills - Eastern | 2,542 | 43 |
| Rural Hills - Central | 2,422 | 45 |
| Rural Hills - Western | 2,452 | 42 |
| Rural Hills – Mid and Far Western | 2,331 | 49 |
| Rural Terai – Eastern | 2,640 | 28 |
| Rural Terai – Central | 2,762 | 23 |
| Rural Terai – Western | 2,590 | 34 |
| Rural Terai – Mid and Far Western | 2,515 | 37 |

Where F = cumulative logistic probability function, e = base of natural logarithm, and $P_{1/i}$ = probability that the individual makes a certain choice. Futhermore,

$$P_{1/i}(1+ e^{\alpha + \beta X i}) = e^{\alpha + \beta X i}$$

$$P_{1/i} = (1- P_{1/i}) * e^{\alpha + \beta X i}$$

$$P_{1/i} / (1- P_{1/i}) = e^{\alpha + \beta X i}$$

$$\log_e(P_{1/i} / P_{2/i}) = P_{1/i} / (1- P_{1/i}) = \alpha + \beta X_i = Z_i \quad (2)$$

The left-hand side of equation (2) is known as the log odds or the logit transformation and the model is known as the linear logit model. Wigly (1985) pinpointed the importance of logit transformation: it increases from - ∞to + ∞ as $P_{1/i}$ increases from 0 to 1. Thus, while the probability is bounded, the logit is unbounded with respect to the values of X. According to Wigly, the predicted Logit values

$$\hat{L}_{1;2/i} = \log e \left\{ \frac{\hat{P}_{1/i}}{\hat{P}_{2/i}} \right\} = \hat{\alpha} + \hat{\beta} X_i \quad (3)$$

are likewise unbounded, but the predicted probability (which can be found by substituting $\hat{\alpha}$ and $\hat{\beta}$ into equation (3) are confined to a range of 0-1. In this study, $P_{1/i}$ represents the probability that individual household 'i' is self-sufficient for 12 months and 1- $P_{1/i}$ = $P_{2/i}$ = 1/ (1+ e $^{(\infty + \infty X i)}$) represents the probability that individual household 'i' is not. The logistic regression model has been used by Maharjan and Joshi (2011) to identify the determinants of food security and by Joshi, Maharjan and Piya (2012) for identifying variables with a significant impact on income and poverty in Nepal.

The estimation of marginal effects are likewise important. Marginal effects refer to the partial derivatives of the expected value with respect to the vector of characteristics. They are computed at the means of the Xs. Marginal effects show the change in probability when the predictor or independent variable increases by one unit. Since

$$P_{1/i} = \frac{1}{1+ e^{-(\alpha + \beta X i)}}$$

as per equation (1), taking a partial derivative of the above equation with respect to $X_i$, the following formula is derived to estimate the marginal effect of $X_i$:

**Table 2:** Annual growth rate of population and cereals production in Nepal (%) , Source: MOAD (2013b)

| Period | Cereals | Population |
|---|---|---|
| 1981-90 | 5.3 | 2.1 |
| 1991-2000 | 2.3 | 2.3 |
| 2001-2011 | 1.7 | 1.4 |

**Table 3:** Annual compound growth in area, production and yield (%)
Source: Compiled and calculated by the author from MOAD (2014), MOAD (2013a), Ministry of Agriculture and Cooperatives (MOAC, 2005), Department of Food and Agricultural Marketing Services (DFAMS, 1990), and DFAMS (1977)

| Crops/Period | Taplejung | | | Bajura | | |
|---|---|---|---|---|---|---|
| | A | P | Y | A | P | Y |
| Paddy | 5.25 | 5.19 | -0.06 | 0.96 | 1.02 | 0.06 |
| Maize | 3.09 | 3.81 | 0.72 | 0.27 | 1.03 | 0.76 |
| Wheat | 4.05 | 5.84 | 1.79 | 3.44 | 5.10 | 1.66 |
| Millet | 2.76 | 2.46 | -0.30 | 3.08 | 2.90 | -0.18 |
| Potato | 3.47 | 6.40 | 2.93 | 4.59 | 6.84 | 2.25 |

$$\delta P(1/i) / \delta Xi = P1/i \times (1\text{-}P1/i) \times \beta_i \quad (4)$$

## Results and Discussion

The status of agricultural growth, nutrition and consumption, cereal production, and population growth at the national and sub-national level, as well as production and productivity of major crops and socio-economic characteristics of the districts under study are presented in the following sections.

### Agricultural Growth

Agriculture provides a livelihood to two-thirds of the population and contributes about one-third of the GDP in Nepal (Ministry of Finance (MOF), 2015). The structure of the economy in Nepal has changed slightly over the years. The contribution of agriculture to GDP fell by 10% over a period of about 20 years (44% in 1990-92 to 34% in 2012-13). The average rate of real Agricultural Gross Domestic Product (AGDP) growth per annum during 1974 to 1998 remained at 1.77%, while it was 3.62% during 1999 to 2014. It is also evident that this growth is fluctuating: ranging from 4.2% in 2000/01 (MOF, 2002), to 1% in 2006/07, to 5% in 2011/12 (MOF, 2013), to 0.8% in 2014/15 (MOF, 2016).

### Status of Nutrition and Calorie Intake

Nepal's population confronts various forms of nutritional problems, ranging from deficits in energy intake to imbalances in consumption of specific macro and micronutrients. Nepal has a problem of chronic under-nutrition, leading to the stunting of children (NPC, 2012). The cost of mineral and micronutrient deficiencies alone in Nepal is estimated at 2-3% of GDP, equivalent to US$250-375 million annually (NPC, 2012).

The national average dietary energy intake was 2,536 Kcal per capita per day; a level that is higher than the minimum average adequate requirement of 2,220 Kcal set by the Government of Nepal (NPC, 2012). However, poor diet diversity is a serious problem across much of the country. While the average Nepalese consumes sufficient calories, staple food items constitute 72% of the average household diet, which is considered very high (NPC, 2013).

Food energy intake varies significantly between Nepal's geographic regions (**Table 1**). The highest per capita intake of calories was in Rural Terai-Central (2,762 Kcal


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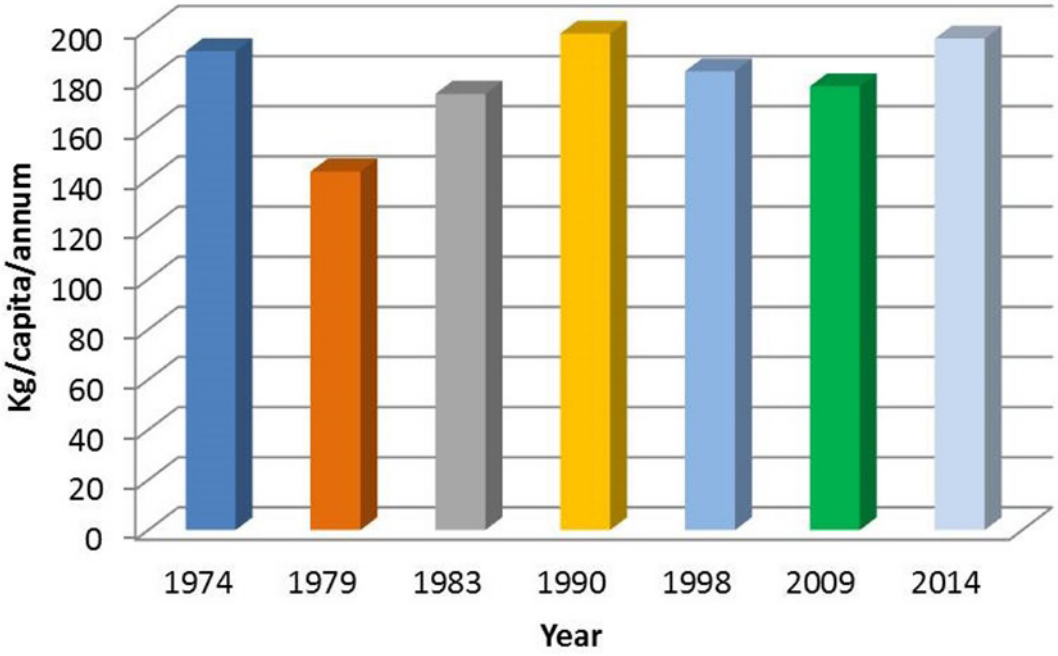


**Figure 3:** Changes in per capita edible food grain availability in Nepal
Source: Compiled and calculated by the author from MOAD (2015), MOAD (2010), MOAC (2005), DOA (2015), DFAMS (1977), DFAMS (1990)

per day), compared to the lowest per capita intake in Rural Hills-Mid and Far Western (2,331 Kcal per day). In the mountains of Nepal, the average per capita intake was below the national average, with 45% of the population consuming less than the national minimum calorie threshold.

### Growth in Cereal Production and Population

Nepal was self-sufficient in food production up until 1990, when population growth surpassed food production growth. During the following decade, substantial efforts were made to restore national food self-sufficiency, which was achieved again in 1999. But this pressure reduced the resilience of Nepal's agriculture and, following adverse weather conditions and natural disasters, national food production has remained insufficient to meet the needs of the population since 2005. Population and cereal production since 1985 have both more than doubled, and are set to double again by 2040 (MOAD, 2013b). The annual population growth rate is falling slowly, and over the last decade, the population growth rate appears to have been lower than the cereal growth rate (**Table 2**).

### Production of Major Food Crops

Rice, maize, wheat and potato are the major food crops in Nepal. These crops account for nearly 71% of the total cropped area and nearly 73% of the production of food crops, including vegetables (MOAD, 2015). The growth in area, production and yield of these crops in the Bajura and Taplejung districts from 1974-2013 are presented in **Table 3**. The growth in production is the sum of growth in area and yield. It shows that area expansion was the major contributor to the increased production of paddy and millet. The contribution of yield growth to total production growth remained at 33-45% in the case of potato, 19-74% for maize and 31-33% for wheat. The yield growth of major crops except potato and wheat remained below the population growth in these districts.

For estimating edible food production and requirement, five major food grains (paddy, wheat, maize, millet and barley) were considered. The per capita per annum edible food grain availability at the national level has fluctuated over time (**Figure 3**). It was 191 kg during 1974/75 (DFAMS, 1977), but decreased to 177 kg in 2009/10 (MOAD, 2010). Subsequently, it increased again to reach a level of 196 kg in 2014/15 (MOAD, 2015; Department of Agriculture (DOA), 2015). The increasing food supply imbalance is mainly due to slow growth in agricultural productivity, limited arable land for bringing additional area under cultivation, and an unfavorable trade balance for the import of food (FAO, 2010). Part of the deficit is met by foods such as potatoes, meat, fish, and eggs. Out of 75 districts, 46 were found to be food deficient during 2006/07, but the number declined to 32 in 2014/15 (DOA, 2015). Although the number of food deficient districts at an aggregate level is decreasing, the mountain districts are particularly vulnerable to food insecurity. Low production and productivity is largely due to the predominance of rain-fed agriculture, traditional farming practices, ineffective agricultural service delivery

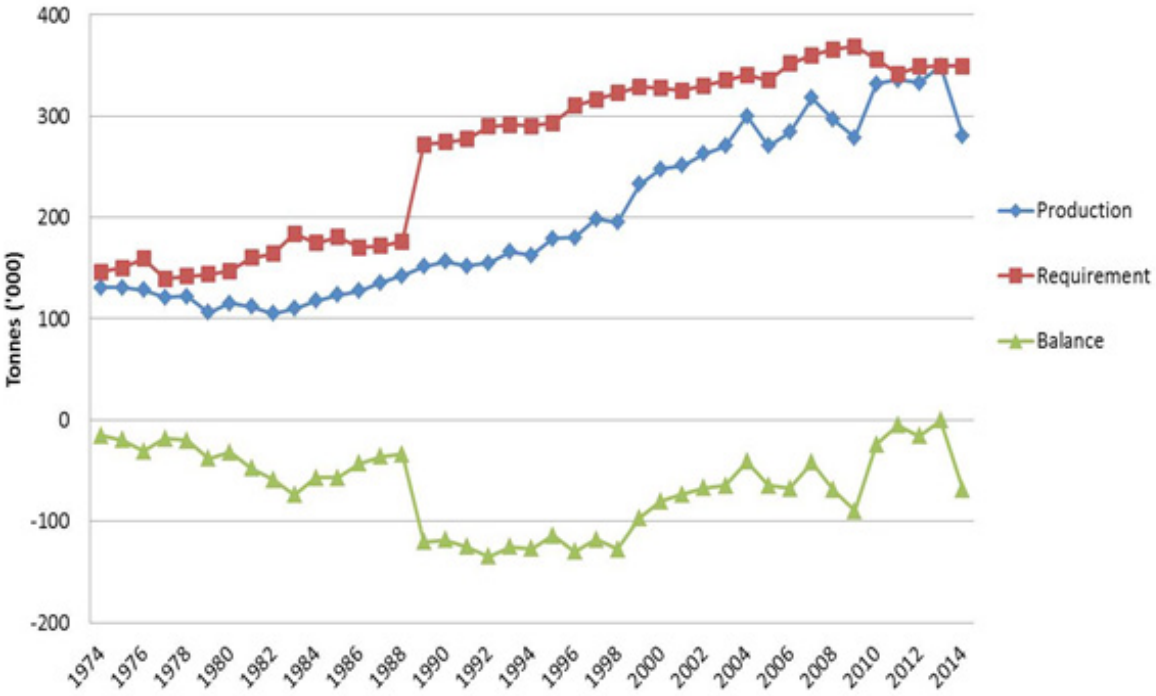


**Figure 4:** Production and requirement of foodgrains (in edible form) in mountains of Nepal
Source: Compiled and calculated by the author from MOAD (2015), MOAD (2013a), MOAC (2005), DOA (2012), DOA (1997), DFAMS (1990), and Joshi and Khatiwada (1986)

**Table 4:** Socio-demographic characteristics of the households, Source: Calculated by the author from CBS (2013)

| Districts | Family size (No. of individuals) | Age of the House-hold Head (Years) | Female Headed Household (%) | Education of House-hold Head (No. of years of schooling) |
|---|---|---|---|---|
| Taplejung | 4.75 | 47.1 | 24.4 | 3.1 |
| Bajura | 5.96 | 43.3 | 15.2 | 2.6 |
| Average | 5.37 | 45.2 | 21.5 | 2.8 |

**Table 5:** Holding size, food self-sufficiency and related information, Source: Calculated by the author from CBS (2013)

| Districts | Holding size (ha) | Area irrigat-ed (%) | Average Food insufficiency (months) | Households with agriculture and allied activities (%) | No. of live-stock |
|---|---|---|---|---|---|
| Taplejung | 0.99 | 32.9 | 2.7 | 96.5 | 7.40 |
| Bajura | 0.29 | 24.9 | 3.6 | 20.0 | 8.69 |
| Average | 0.63 | 29.1 | 3.1 | 60.0 | 8.00 |

and frequent droughts and floods (FAO, 2010).

The food production and balance scenario in the mountainous region of Nepal (which covers 16 districts) shows that the production quantity (in edible form) was below the requirement of the population in the period 1974-


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**Table 6:** Factors affecting household food security in mountain districts of Nepal

| Variable | Marginal effects |
|---|---|
| Constant | -0.567 |
| AGE HHHEAD | 0.0025** |
| FAMILY SIZE | -0.0022** |
| PERCENT IRRIGATED | 0.222*** |
| MARKET DISTANCE | -0.023** |
| NO. OF LIVESTOCK | 0.009*** |
| HHHEAD DUMMY | 0.102** |
| AG OTHER SOURCES DUMMY | 0.168*** |
| DISTRICT DUMMY | 0.093* |
| OWN LAND DUMMY | 0.026* |
| Likelihood Ratio (Chi-square) | 104.74*** |
| Pseudo R-square | 0.10 |

***, ** and * indicate significance at a 1%, 5% and 10% probability level, respectively.

2014. It has also been fluctuating from year to year (**Figure 4**). In Nepal, almost all the mountain districts and some hilly districts have remained continuously food deficient over the last three or four decades.

**Socio-economic Characteristics**

The demographic and socio-economic characteristics of EAs of the two study districts are presented in Table 4. On average, the family size was 5 persons, the age of the household head was 45 years, the education level of the household head was just 3 years of schooling, and 21.5% of households were headed by a female. The dependency ratio, which is defined as the ratio of the dependent population (less than 15 years old and more than 60 years old) to the working age population was 0.78. This means that for every 100 working persons, there are 78 dependents).

The results showed that on average, the cultivated land per household was 0.63 ha, around 29% of the cultivated land was irrigated, and the households experienced food shortages for about 3 months of the year. Moreover, 60% of the households engaged in non-farm activities as well as working in agriculture (**Table 5**). However, the table also indicates the considerable difference in landholding size and percentage of households engaged in both agriculture and allied activities between the two districts: the figures for Bajura are very low compared with Taplejung.

**Results of the Logit Model**

The results of the logit model show that all the included variables were significant in influencing household food security (**Table 6**). The age of the household head, proportion of male-headed households, household size, and distance to market were significant at a 5 percent probability level. Among these variables, the household size and distance to markets negatively influenced food security, while the other two variables have a positive influence. The percent area irrigated, household members with both agriculture and allied occupation, and number of livestock were significant at a 1% probability level, while the district dummy and land ownership dummy were significant at a 10% probability level. The likelihood ratio was found to be highly significant, which implies that the level of food security is explained by the significant explanatory variables.

Male-headed households (HHHEAD DUMMY) were about 10% more likely to be food secure than female-headed

households. With one unit increase in the irrigated area (PERCENT IRRIGATED), the probability of food security increased by 22%. The significant positive relationship of household members with both agricultural and other income sources (AG OTHER SOURCES DUMMY) with food security implies that the diversification of employment opportunities among household members reduced the risk to income generation and hence contributes to food security. This may be due to the fact that households engaged in non-farm activities were better endowed with additional income and more likely to escape food insecurity. Similarly, the smallholders who solely depended on farm activities could have had inadequate income to purchase farm inputs and fulfill family needs and thus, they were found to be more food insecure. The households who had other allied occupations in addition to agriculture had an increased probability of being food secure of about 17%.

In general, households who earn their livelihoods from limited resources, such as land, may face food insecurity with increased family size (FAMILY SIZE). Indeed, bigger households were more likely to be food insecure than smaller ones: each additional household member increased the probability of a household being food insecure by 2.2%. The distance to market variable (MARKET DISTANCE) appeared to be negative and significant at a 5% level, which was unexpected. This could be because the roads and market facilities for buying and selling goods were not well-developed in the mountain districts. Most of the households walked to reach the nearest markets, which took four hours on average.

The age of the household head (AGE HHHEAD) variable shows that with a one year increase in the age of the household head, the probability of food security increased by 0.26%. With increased age, the household head gains experience in managing food insecurity by developing relevant coping strategies. The positive and significant dummy variable for ownership of the land (OWN LAND DUMMY) shows that the probability of food security was 7% higher for owner operators than for tenants. The district dummy (DISTRICT DUMMY: 1 for Taplejung, zero otherwise) variable was positive and significant, which implies that Taplejung (eastern mountains) was more food secure than Bajura (far-western mountains). The probability of being food secure was 9% higher for Taplejung than for Bajura.

The number of livestock (NO. OF LIVESTOCK) owned by a household had a significant positive influence on household food security. Livestock have many socio-economic benefits to farm households and are perceived as indicators of wealth; therefore, the possession of greater numbers of livestock implies a higher likelihood of food security. Possession of livestock mitigates the vulnerability of households during crop failures and other calamities. With one unit increase in livestock number, the probability of a household being food secure increased by 0.90%.

## Conclusion

This study was carried out to review and assess the relationship between agricultural production and household food security, as well as identify major factors that influence food security. The study results show that female-headed households are more food insecure compared to male-headed households, while age of the household head is positively related to household food security. Similarly, households with a larger percentage of cultivated area with irrigation, members having off-farm occupation, a higher number of livestock, and status as the owner operator all contributed positively to food security. Bigger family size and greater distance to the nearest markets contributed negatively to household food security. The food security was higher in the eastern mountain districts compared to the far-western mountain districts. The findings imply that monetary and non-monetary support are needed by female-headed households to improve their food security. In addition, a financial, technological and skill-enhancing package should be provided to economically active household members to facilitate participation in on-farm value-added processing and off-farm activities. Investment should be increased in public goods, such as markets and road infrastructure in rural areas in order to improve physical access. Similarly, additional irrigation facilities need to be developed to augment the quality of land. Moreover, improving access to land and its utilization based on comparative advantage could improve household food security in the rural areas of Nepal.

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## Conflict of Interests

The authors hereby declare that there is no conflict of interests.

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**Research Paper**

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# Adapting Gambian women livestock farmers' roles in food production to climate change

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women; livestock farmers; climate change, adaptation strategies, stakeholders, policies

**Abstract**

Women livestock farmers are very productive and contribute greatly towards ensuring food security of their nations. However, their efforts are sometimes limited by climate-related hazards. This case study of The Gambia used content analysis, interviews, consultative seminars, policy mapping and dialogues to examine climate change adaptation issues confronting women livestock farmers in particular. Consequences of climate hazards, such as drought, flood, and temperature variability, have been experienced in The Gambia. Domestication of fast-growing small animals, use of resilient livestock breeds, stock size management, feed gardening and conservation, bushfire control, and regular supply of water to animals can reduce farmers' exposure to climatic variations. There were varied opinions among male and female stakeholder groups concerning adaptation options, such as rangeland management and bush fire control. Enhancing the adaptive capacities of women livestock farmers will involve many stakeholders: the government, research institutions, extension service agencies, non-governmental organizations, and the private sector have varying but complementary roles to play.

## Introduction

The quantity of food produced and how impacts of climate change are felt by male and female farmers may not be the same, even when they are located in the same environment. Some studies have focused on the effects of gender in determining adaptation strategies utilized by farmers (Arora-Jonsson, 2011; Below et al., 2012; Deressa et al., 2009; Djoudi & Brockhaus, 2011). Most of the existing literature regarding this aspect deals with crop farming, while there are just a few studies concerning how women livestock farmers, especially in the developing countries of Africa, are adapting to climate change. Focusing on The Gambia and with emphasis on the feed and livestock resources, the present research hypothesizes that remarkable disparities exist between men and women livestock farmers in terms of their climate change adaptation strategies for food production and management.

The Gambian agricultural sector is predominantly traditional and largely depends on rainfall, which lasts for four to five months of the year. In addition to tourism, this sector is a main pillar of the country's economy. Given a projected population of 4,466,000 by 2040 under a constant fertility scenario (UN, 2012), the number of Gambian livestock, as well as their productivity needs to increase substantially in order to meet the expected food demand. However, there is a challenging relationship between livestock production and variations in climatic elements (Challinor et al., 2014; Nardone et al., 2010; Thornton et al., 2009; Thornton & Herrero, 2010; Weindl et al., 2015). Depending on their magnitude, climate hazards have negative effects on livestock species and farmers whose livelihoods are sensitive to climate change (Olaniyan & Orunmuyi, 2017). A typical incident was the climate-induced flooding of some farming communities in North Bank of The Gambia in 2010, which led

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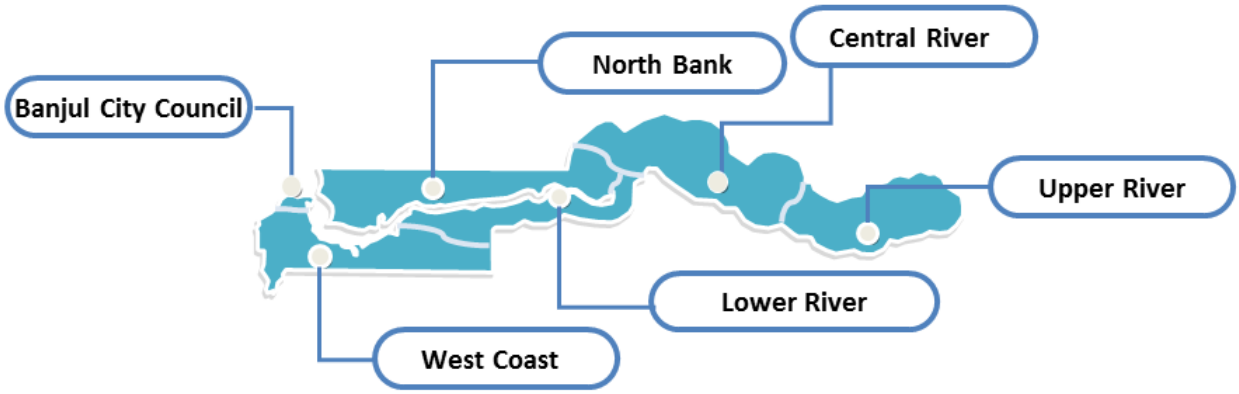


**Figure 1:** Map of The Gambia showing the study areas
(Source: with Author attribution n template by Yourfreetemplates )

to economic loss of livestock and other important farm assets. In addition, the Gambian agricultural sector's performance with regard to livestock production has been fluctuating in relation to climate change hazards, with effects such as seasonal feed shortage (Olaniyan, 2016). The Gambian women farmers, who are particularly known for cultivating horticultural and food crops (Sanyang et al., 2009), as well as keeping poultry and small ruminants, are affected by variations in climatic elements (Olaniyan, 2016). According to the country's National Gender Policy (2010), the Gambian women smallholder farmers contribute up to 70% of the total food and agricultural labour force, but their productivity is less than that of male farmers. FAO (2011) has also reported a lower quantity of food production, leading to meagre income for some women farmers as compared to their male counterparts. Despite their ability to enhance climate change adaptation, food production, livestock and environmental management, Olaniyan (2016) documented that Gambian women livestock farmers still have limited access to resources and are less involved in decision and policy making.

Concerning the challenges of adapting The Gambia's livestock subsector to climate change, inadequate data for resource planning and poor exchange of data among stakeholders has been reported (ANR, 2009). There is little research concerning the potential of adaptive breeds and feed resources in the Gambian context. Considering their key roles in food production, food waste management and climate change adaptation, this study focuses on key climate change adaptation issues confronting women livestock farmers. The general objective is to suggest livestock feeding and production strategies that can be used by livestock farmers in their efforts to produce food and adapt to undesirable impacts of climate change, especially in the smallholder farming systems. Evidence-based information generated in this study can inform future policy making and livestock development activities.

## Methodology

### Study area

The Gambia is located in the Sudano-Sahelian zone of West Africa, with a climate typically characterized by a short rainy season from June to October and a dry season from November to May. The country (**Figure 1**) is bounded on the western side by the Atlantic Ocean, while its length along the north-south horizon is almost entirely divided into two by the River Gambia. Average daily temperature in the country varies, but it increases with distance from the ocean. Agriculture is one of the country's main productive activities. According to UN (2012), more than 50% of the total Gambian land mass is used for agriculture and food production purposes. The Gambia is one of the smallest and most densely populated countries in mainland Africa.

### Data collection methods

Government, policy and institutional documents on women, agricultural development and climate change in The Gambia were reviewed using content analysis. This step was used to gain insights into the past, present and intended efforts of various stakeholders. The documents included Gambia Environmental Action Plan (GEAP, 1992), Poverty Reduction Strategy Paper (PRSP, 2006), National Adaptation Programme of Action (NAPA, 2007), Nationally Appropriate Mitigation Actions (NAMA, 2007), Agriculture and Natural Resources (ANR, 2009), The Gambia National Gender Policy (GNGP, 2010), Gender and Women Empowerment Policy (GWEP, 2010), Gambia National Agricultural Investment Programme (GNAIP, 2011), and Intended Nationally Determined Contribution of The Gambia (INDC, 2015). The keywords included livestock, resilience, feed, strategy, farmer, climate, women, adaptation, and agriculture. Policy and stakeholder mapping was used to emphasize certain

**Table 1:** Climate change-related risks for livestock production in The Gambia

| Risks | Consequences |
|---|---|
| Drought | • Inadequate pasture for livestock feeding<br>• Shortage of water due to drying up of watering points<br>• Land degradation and desertification due to overgrazing<br>• Death of animals due to starvation |
| Climate-induced flooding | • Death of animals<br>• Reduced adaptive capacity of livestock farmers due to loss of natural resources |
| High Temperature | • Death of animals from heat wave<br>• Drying up of watering points, such as rivers |
| Climate-induced pest infestation | • Reduced productivity of animals and their owners<br>• Emaciation and death of animals |

information, indicate the trends in important events and categorize the group of actors identified during the study. Relevant information was summarized as text, figures, and tables.

The content analysis was complemented by a consultative seminar. This step was used to gather additional information from stakeholders in research institutions, community-based organizations, farmers' associations, government agencies, non-governmental organizations, women's groups, and the private sector. The participants were divided into separate male and female groups, while the same task, namely, to mark various adaptation options arranged in a tabulated format, was given to both groups. These tasks, based on predefined criteria of whether each adaptation option could reduce farmers' exposure and sensitivity to climatic elements or enhance their adaptive capacities were accomplished through group discussions. A maximum of three '+' marks for each option was possible. Thereafter, there was a plenary session wherein the findings of each group were presented, compared and further discussed. Interviews, secondary data obtained from UN (2012), policy mapping and dialogue involving the previously mentioned stakeholder groups were also utilized.

## Findings

### Livestock and climate-related challenges in The Gambia

According to The Gambia's Agricultural and Natural Resources Policy (ANR, 2009), livestock species in the country include cattle, sheep, goats, horses, donkeys, pigs and poultry. Based on data from UN (2012), cattle and chicken are the most commonly reared species in the country, although their populations varies across the monitored years. Meanwhile, the livestock subsector of this country is mainly traditional and relatively under-exploited. Climate-related hazards, such as drought, flood, and temperature variability, as well as some of their consequences as previously observed in The Gambia are explained in **Table 1**. Livestock and crop sensitivity to the impacts of climate change partly accounted for lower productivity per animal and total food production in terms of milk, meat and eggs. Factors such as the presence of disease vectors and inadequate access to inputs, such as feed, veterinary and extension services, also influenced the type of livestock species and production systems that farmers adopted in meeting their food requirements.

### Food production and management-related adaptation options for livestock farmers

Some feasible adaptation options identified from NAPA (2007) and found applicable to both men and women livestock farmers are presented in Table 2. There were some similarities in those options marked as '+' by both male and female groups. However, there was not a consensus between male and female stakeholders for certain adaptation strategies, such as controlled use of bush fire and rangeland regeneration and management.

### Feed production strategies

Concerning the issue of feed shortage, which can be an effect of variations in climatic elements, such as rainfall, the following strategies can enhance women livestock farmers' resilience:

- Establishment of a fodder tree plantation including intensive feed gardens


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**Table 2:** Ranking of adaptation options by separate male and female groups

| Adaptation options and their relationship to vulnerability in the livestock subsector | Adaptation potential | | | | | |
|---|---|---|---|---|---|---|
| | Women group | | | Men group | | |
| | 1 | 2 | 3 | 1 | 2 | 3 |
| Genetic improvement of animals | + | | + | | + | + |
| Provision of adequate water for animals | + | | | | | + |
| Domestic farming of fast-breeding small animals | | + | + | | | + |
| Controlled use of fire | + | | | + | + | + |
| Establishment of intensive feed gardens | | + | | + | | + |
| Demarcation of rangelands | + | | | + | + | + |
| Stock size management | + | + | | | + | + |
| Restricted grazing | + | | + | + | | |
| Rangeland regeneration and management | + | | | + | + | + |
| Animal vaccination | | + | + | + | + | + |

**Legend:**
1 = option can reduce frequency, duration or severity of a farmer's exposure to climatic elements.
2 = option can reduce degree to which a farmer is sensitive to variations in climatic elements.
3 = option can increase ability of a farmer to withstand or recover from climate-related shocks.

- Fallowing of farmland
- Building capacities of farmers regarding feed formulation, processing and storage
- Utilization of compost to improve soil fertility
- Bushfire control
- Feed resources conservation
- Increased dry season feed production
- Demarcation/regeneration of rangelands

**Animal production and breeding strategies**

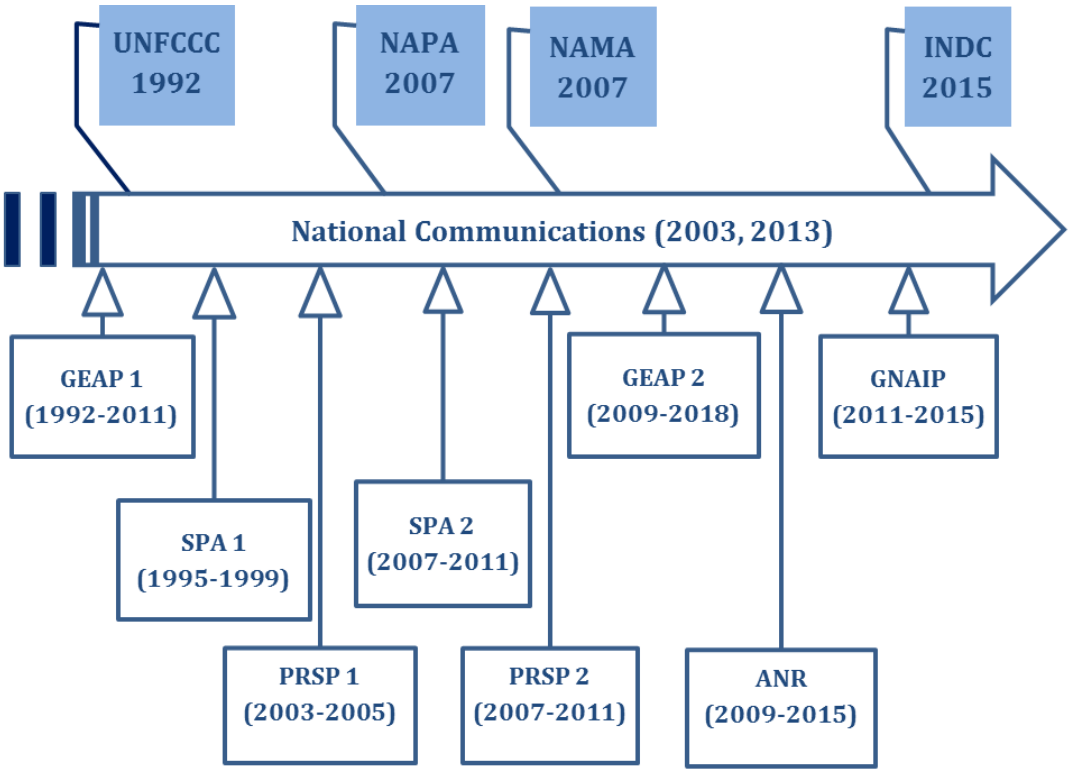
The following animal husbandry strategies can improve Gambian women livestock farmers' adaptation to climate change:

- Use of resilient livestock breeds, e.g., N'Dama cattle, Djallonke sheep, local poultry and their adaptive crossbreeds
- Keeping short-cycle animal species, e.g., quails, grass-cutters, rabbits
- Use of improved but locally-adapted forage varieties, e.g., Panicum maximum and Andropogon gayanus
- Control of vector breeding sites and habitats
- Breeding, genetic improvement, and utilization of appropriate breeds
- Improved management of agro–pastoral infrastructure
- Semi-intensive livestock production systems
- Research and extension on animal genetic resources

**Strategies involving policy and stakeholders**

The challenge of food shortage linked to climate change was recognized by the Gambian government and some other stakeholders. In terms of managing causes and effects of climate change, Figure 2 illustrates some of the Gambian government policies and strategies at the international (upper boxes) and national levels (lower boxes). The central arrow in the middle indicates that the country's two national communications on climate change, which were released in 2003 and 2013.

In addition to the various policy and institutional documents depicted in **Figure 2**, indications of how women livestock farmers' adaptation strategies and sustainable food production can be collectively achieved are illustrated with **Table 3**. The roles described here are not independent of each other, but are rather complementary.




Keys: NAPA= National Adaptation Programme of Action; NAMA= Nationally Appropriate Mitigation Actions; INDC= Intended Nationally Determined Contribution of Gambia; SPA= Strategy for Poverty Alleviation; ANR= Agriculture and Natural Resources; GNAIP= Gambia National Agricultural Investment Programme; GEAP= Gambia Environment Action Plan; PRSP= Poverty Reduction Strategy Paper; UNFCCC= United Nations Framework Convention on Climate Change.

**Figure 2:** Relevant policy and institutional landscape on climate change adaptation and livestock in The Gambia

**Table 3:** Relevant stakeholders and their expected roles

| Stakeholder groups | Expected roles |
|---|---|
| Livestock producers | • Create awareness concerning use of climate-smart production strategies |
| Government | • Provide legislation, regulations, policies, development and funding for adaptation projects |
| Research institutions | • Identify best practices through climate-oriented research<br>• Provide evidenced-based facts for policy advocacy, design and implementation |
| Extension service agencies | • Provide communication, education and information services to farmers by complementing government and other stakeholders' efforts. |
| NGOs/CSOs/CBOs | • Support policy implementation, funding, and training on climate-smart methods of livestock farming and food waste management |
| Regional & international development partners | • Provide funding and technical support to government and other stakeholders on climate change issues |
| Private sector | • Invest in technologies, trainings and solutions that can enhance farmers' resilience |

* NGOs = non-governmental organizations; CSOs = civil society organizations; CBOs = community-based organizations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## Discussion

### Vulnerability of The Gambia's livestock sector to climate change

The use of content analysis for qualitative assessment of policy and institutional documents in this study were discussed by Bowen (2009), Cho and Lee (2014), Elo and Kyngäs (2008), as well as Vaismoradi et al. (2013). To address some limitations associated with this method, content analysis was combined with interviews, policy dialogues, and policy mapping in this study. Separating respondents into male and female groups during a consultative meeting provided a basis to understand gender differences among male and female livestock farmers in terms of adapting their food production and management to climate change impacts. Further study is required to understand the rationale behind individual farmer's choices in comparison to their collective decisions or activities.

The Gambian livestock subsector is exposed to climate-related hazards because of the country's geographical location in the Sahelian zone of sub-Saharan Africa. Low productivity of this agricultural subsector has been linked to its dependence on natural resources, such as water, pasture and rangelands (ANR, 2009). Weindl et al. (2015) indicated that natural resources on which livestock production systems in developing countries depend are particularly vulnerable to the impacts of climate change. The challenges of climate change are not unique to this country, but are also noticeable in some other developing countries of Africa (Challinor et al., 2007; Jones & Thornton, 2009; Kima, et al., 2015). However, Gregory et al. (2005) pointed out that there are differences among countries with regard to the impact of climate change on food security. Concerning the vulnerable countries, a decrease in land suitable for crop production may necessitate a change from crop to livestock production (Jones & Thornton, 2009). This is because adapted livestock species in the dry areas can survive well on degraded lands when compared to some crop varieties.

For The Gambia, availability of feed resources correlates with season of the year, with more forage for animals in the wet season compared to the dry season. This makes farm animals and the livestock subsector vulnerable to variations in climatic elements, such as rainfall and its unpredictable patterns. It also causes seasonal migration of animals and herdsmen in search of both water and grasses during the dry season. However, The Gambia's NAPA (2007) indicated that many rangelands which are owned by communities are not properly managed or are occasionally destroyed by bush fire. Recurrent, indiscriminate burning of rangelands can result in destruction of natural resources which could have otherwise enhanced the adaptive capacities of farmers during critical periods of the year (Olaniyan, 2016). Relationships between rangeland management and the nutritive value of livestock feed (Abusuwar & Ahmed, 2010), biogeochemical cycles (Rumpel et al., 2015), rural livelihoods (Eriksen, 2007) and food production (Alkemade et al., 2013) exist in the literature. In this regard, the 240,000 ha (UN, 2012) which are available for pasture production and transhumance in The Gambia need to be sustainably utilized in order to safeguard against undesirable outcomes. A cost-effective tidal and pump irrigation for continuous crop and livestock production which was suggested in the Gambia National Agricultural Investment Programme (2011-2012) could be considered as one of the options that could reduce pressure on the existing rangeland used for pastoral farming

There are some indirect effects of climate change on livestock species and their owners, such as food waste and economic costs incurred in treating sick animals and controlling the spread of climate change-borne disease pathogens or vectors. There is also a challenge of food waste resulting from underutilization of animals and poor storage of perishable products, such as milk, eggs and meat. In the Gambia's NAPA (2007), high mortality rates and significant reduction in milk yield, growth rates and reproductive rates of animals were documented. However, smallholder food production and management systems can also be affected by the quality of inputs and methods used by farmers. The effects of climate change could hamper the policy goal to "meet at least 75% of national food demands in terms of meat and meat products" (ANR, 2009), as expressed in the country's Agricultural and Natural Resources Policy document.

### Addressing women livestock farmers' vulnerability

The Gambian women livestock farmers are vulnerable to the impacts of climate change because of their unavoidable reliance on agricultural produce as both sources of food and livelihood. However, their abilities to diversify into non-agricultural sources of livelihood, use of indigenous knowledge, and access to family labour, can increase their resilience (Morton, 2007). A change of farming systems was suggested by Thornton & Gerber (2010). In this regard, Havlík et al. (2014) indicated that a change from grazing to combined crop-livestock production systems would both reduce both deforestation and greenhouse gas emissions. Meanwhile, a mixed farming strategy can reduce food waste because animals can thrive on the residues left after harvesting crops, while animal faeces in turn are potential sources of fertilizer for

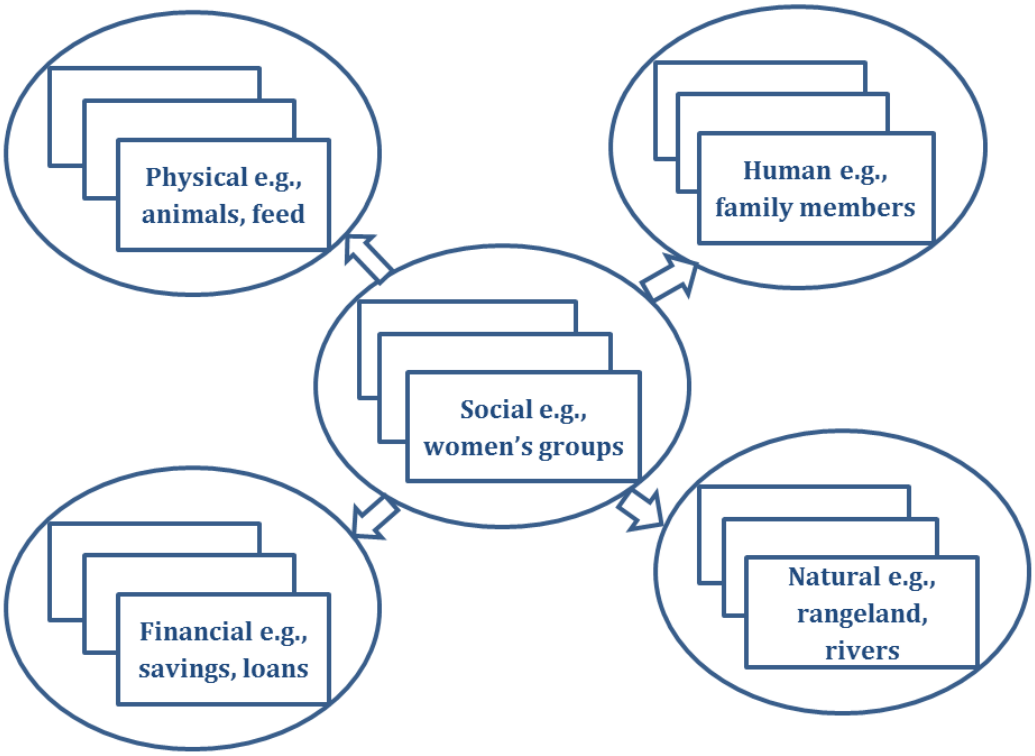


**Figure 3:** Typical assets that can improve women livestock farmers' adaptation to climate change

crop production. Vulnerability analysis was suggested by Godber & Wall (2014) concerning prediction of climate change impacts on food security. Selling of animals by both male and female livestock owners just before harvest of new crops has been documented in The Gambia (Yaffa, 2013). A consequence of this strategy for vulnerable women livestock farmers is gradual reduction in their livestock-based assets, especially if the animals sold are not frequently replaced. This practise can decrease farmers' subsequent ability to cope with climate change and food management-related challenges.

In The Gambia, Olaniyan (2015) indicated that women are mostly engaged in poultry and small ruminant production. Based on this, five forms of assets (i.e. physical, human, natural, capital, and social) potentially owned by vulnerable women livestock farmers were identified, as illustrated with Figure 3. The physical assets include locally-adapted animal breeds, such as West African Dwarf goat, Djallonke sheep, and N'Dama cattle. There are also locally available feed resources. The use of crop residues preserved on the roofs of houses as feed for cattle, goat and sheep during the dry season is a common practise. Meanwhile, this is still insufficient in terms of the quantity and quality needed to meet the nutritional requirements of those animals. To date, there is little research concerning the overall effectiveness of this practise and how it enhances farmers' adaptation to climate change or food production.

As also depicted in **Figure 3**, women livestock farmer groups or networks are important social assets. Women farmers can leverage this asset in order to access other forms of assets. The same claim is true for their human assets, which include family members. The relevance of microfinance institutions as a financial asset in supporting climate change adaptation in Indonesia's agricultural sector was discussed by Budiman et al. (2016). However, inappropriate use of available assets by farmers can cause food waste and distortion of the sharing process, especially at the retail levels of buying and selling. Whenever this happens, women livestock farmers, because of their dual productive and reproductive activities, can be more affected than their male counterparts in terms of meeting their food requirements. Olaniyan et al. (2015), who assessed institutional aspects of some Gambian livestock farmers', recommended a need for their capacity development. Figure 4 depicts how farmers, because of poor coping strategies, can be exposed to a deeper level of poverty and other unintended social consequences, which include an enlarged gender gap. The parts of **Figure 4** marked with red borders indicate the areas where women livestock farmers are very vulnerable.

### The role of stakeholders in this perspective

Many stakeholders with various responsibilities were identified in this study. This indicates that the tasks of enhancing adaptive capacities of women livestock farmers and reducing food waste due to climate change requires active involvement and good coordination of many stakeholders. In addition to policy design and


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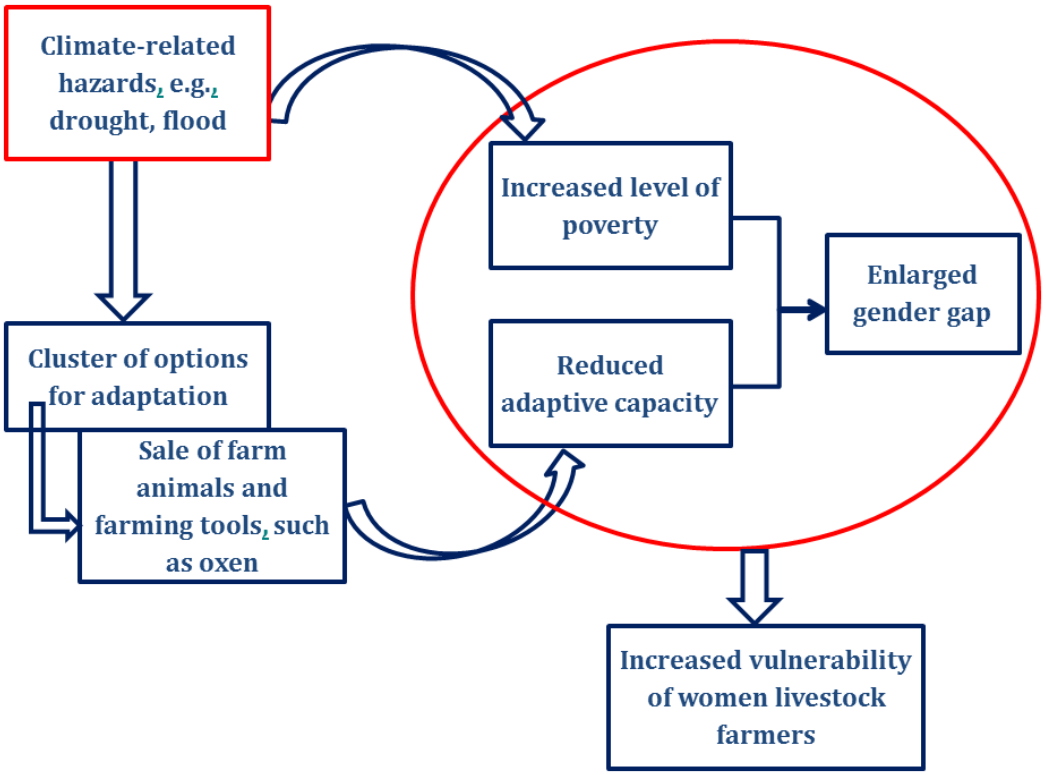


**Figure 4:** Women livestock farmers' vulnerability as a result of poor coping strategies

implementation, as mentioned by Olaniyan (2015), the government needs to work in partnership with other stakeholders to ensure a climate-resilient economy and livestock development. A multilevel governance approach was suggested by Amundsen et al. (2010), while Mees et al. (2012) emphasized collaboration between the private and public sector. Since gender is an important crosscutting issue in climate change adaptation, every stakeholder should ensure that this subject is well incorporated into initiatives, projects and programmes. Meanwhile, efforts to enhance climate change adaptation strategies of women livestock farmers should not be dissociated from economic development because both are mutually and closely interdependent. The stakeholders' roles in climate change adaptation, as illustrated in this study, are also relevant for food waste management.

## Conclusion

Women livestock farmers, because of their dual reproductive and productive responsibilities, are particularly more vulnerable than their male counterparts. Their poor adaptation strategies often predispose them to fall into deeper levels of poverty, thereby enlarging the gender gap. Among many possible adaptation strategies for the livestock sector is the utilization of resilient livestock breeds, such as N'Dama cattle, Djallonke sheep, and the West African Dwarf goat, which can adapt to the prevailing environmental conditions of the country. Feeding strategies, such as restricted grazing, bush fire control, intensive feed gardening, and good management of rangelands were also identified as viable options. While each adaptation option can help address the challenges of climate change and food waste in The Gambia, no single option is sufficient by itself. Furthermore, effective implementation of adaptation strategies needs to be enhanced through favourable policies and cooperation of relevant stakeholders at all scales. This study generated additional evidence to prove that gender differences sometimes exist between male and female livestock farmers in terms of the climate change adaptation strategies used in food production and management. It is recommended that this gender difference should be thoroughly considered in developing climate change adaptation strategies, interventions and policies.

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**Conflict of Interests**

The author hereby declares that there is no conflict of interests.

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## For the first time, genetically-modified salmon is approved to be sold in the Canadian markets

Photo credit: Randychiu (via flickr)

Genetically-engineered Atlantic salmon (AquAdvantage® salmon) has reached the Canadian market after being approved by Health Canada and the Canadian Food Inspection Agency in May 2016. The modified fish was developed in AquaBounty Technologies labs, Massachusetts, USA. It took the company 25 years of research to produce AquAdvantage® salmon, which are currently being raised in tanks in a small facility in Panama and a fish farm in Indiana, USA.

Although the US Food and Drug Administration (FDA) had also approved the salmon for consumption in November 2015, it has not make its way to American tables yet because of the ongoing debate over the labeling procedures for genetically modified products. The genome of the wild Atlantic salmon, containing some 40,000 genes, was modified by adding a growth-hormone gene from a Pacific salmon. In addition, a gene regulator from an ocean pout was added to the genome of the modified fish. AquAdvantage® salmon was basically engineered to grow faster and larger than normal salmon and to reach the marketable size in approximately half the time. Selling transgenic products in Canada is seriously opposed by many Canadian, though 4.5 tonnes of non-labeled AquAdvantage® salmon was sold in July 2017.

Waltz, E. (2017, August 04). First genetically engineered salmon sold in Canada. Nature. Retrieved from *https://www.nature.com/news/first-genetically-engineered-salmon-sold-in-canada-1.22116*

## Is food insecurity really affecting our mental health?

Photo credit: Ted McGrath (via flickr)

Although global food production has increased noticeably over the past decades, more than 795 million people are undernourished worldwide and affected directly by food insecurity. Homeless people are under vulnerable condition in developed countries as well. Their living standards are precarious. A new study based on data from 149 countries and published in the American Journal of Preventive Medicine revealed a significant association between food insecurity and poorer mental health as well as specific psychosocial stressors worldwide. Nearly one third of the earth's population experiences a common mental disorder during their lifetime, such as depression, anxiety, and somatic symptom disorders. The researcher, Andrew D. Jones from the University of Michigan, USA, suggests that food insecurity may contribute to common mental disorders in three ways. First, by generating uncertainty over the ability to maintain food supplies or to acquire sufficient food in the future, food insecurity can provoke a stress response that may contribute to anxiety and depression. Second, acquiring foods in socially unacceptable ways can induce feelings of alienation, powerlessness, shame, and guilt that are associated with depression. Finally, food insecurity may magnify socioeconomic disparities within households and communities that

could increase cultural sensitivities and influence overall mental well-being. The research was conducted based on data from the 2014 Gallup World Poll, which is a series of nationally representative surveys of adult individuals and covers urban and rural areas. Mental health status was determined using the Negative Experience Index and the Positive Experience Index, and two five-question surveys that examined topics such as pain, sadness, enjoyment, feelings of respect, and other factors.

Medical Xpress. (2017, April). Food insecurity can affect your mental health. Medical Xpress. Retrieved from *https://medicalxpress.com/news/2017-04-food-insecurity-affect-mental-health.html*

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## The 3rd German Future Earth Summit (2018): A platform that turns Knowledge into Action


The German Future Earth Summit (2018) in Berlin, the 3rd of its kind, is a national gathering that provides an opportunity for German researchers and stakeholders to network and exchange ideas on global sustainability. The main focus of the 2018 Summit, held on February 8th and 9th, will be Future Earth Knowledge Action Networks (KANs). The German Committee Future Earth is now inviting the German Future Earth and World Climate Research Programme communities, as well as all researchers and stakeholders interested in discussing topics related to Health, Natural Assets, Ocean, Sustainable Consumption & Production, Sustainable Development Goals, Transformations, Urban, Water-Energy-Food Nexus, and Finance & Economics in the context of the Knowledge Action Networks. More information at *https://www.dknsummit18.org*

## Tropentag 2017, Bonn, Germany

Tropentag is an annual, international, interdisciplinary conference on research in tropical and subtropical agriculture, natural resource management and rural development. This year, the 19th annual Tropentag was held in Bonn, Germany on September 20 - 22, 2017. It was organized by the University of Bonn and the Center for Development Research in cooperation with the University of Berlin, University of Göttingen, University of Hohenheim, University of Kassel-Witzenhausen, University of Hamburg, ZALF e.V., ETH Zurich, Czech University of Life Sciences in Prague, University of Natural Resources and Life Sciences in Vienna, the Council for Tropical and Subtropical Research, and the GIZ Advisory Service on Agricultural Research for Development.

The main theme was "Future Agriculture: Social-ecological transitions and bio-cultural shifts," but this main topic carried with it around 30 diverse subtopics including biodiversity, institutions and livelihood, soil and soil fertility, land use and land use change, agricultural and food technology, markets and many others. As in every year, Tropentag opened the door for participation, contribution and discussion among all people who are interested and engaged in agricultural research and rural development in transition, including students, Ph.D. students, scientists, extension workers, decision makers, politicians and practical farmers. Over 1,000 registered participants from more than 68 countries were assembled to discuss the vision of a new path for agriculture. More than 260 poster presentations, 170 oral presentations and 8 workshops took place. Many interactive and interesting discussions were held after each session. In addition, different questions related to the implications of recent developments and change processes for food security, resource base quality, rural well-being, and the future of agriculture in general were addressed during the plenary presentations and key note lectures in thematic sessions. During the three days of the conference, the audience was excited and enthusiastic to listen and discuss. Sometimes one and a half hours, which is the general session time, was not enough for all the researchers to present their work and


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discuss all the questions that were raised.


Photo credit: Tropentag (via flickr)

TT 2017 organizers tried their best to provide all the necessary resources for the speakers and participants, such as organizing pre-workshops, providing a good internet connection and even offering a child care service. TT 2017 was covered on social media by a special team of "Student Reporters" who dedicated their time and efforts to cover all activities, workshops, oral presentations and poster sessions. In addition, they conducted interviews with participants and keynotes speakers to learn more about their future contribution to achieving more sustainable agriculture, and recorded the audience's expectations and feedback about the conference.

On the second day, a social dinner was organized to give a chance for the junior scientists to socialize and make connections with other participants and organizations. The dinner was a huge gathering for researchers from all over the world to meet, discuss their interests, socialize, and exchange knowledge. This year, TT 2017 was, as usual, a huge scientific meeting that paves the way for youth, junior and senior scientists to make the best contribution towards a better future.


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# India's Evergreen Revolution

**"You are not Atlas carrying the world on your shoulder. It is good to remember that the planet is carrying you." - Dr. Vandana Shiva**

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**Abstract**

Global food security is one of the most pressing challenges the world is facing today. In an era dominated by fast-paced technological and digital progress in the agricultural landscape, famines still break loose and continue unabated in certain parts of the world. The recent hunger crisis that erupted in the Horn of Africa only further reaffirms this claim. The problem of hunger and malnourishment extends beyond the frontiers of Africa. Despite its economic achievements, India hosts the world's largest number of undernourished and malnourished people. Using India as a case study, this article attempts to situate hunger and food insecurity in a multidimensional context, which is not only triggered by natural factors (e.g. climate change and natural disasters) but also stems from structural inequality existing in the domestic and global order. The Sustainable Development Goals (SDGs) outlined in the Agenda 2030 stress achieving zero hunger and enumerate further sub-goals to serve as blueprints for its execution. Against this background of hunger and food security, India is analysed for its capacity and performance in achieving the target of zero hunger. Additionally, this paper seeks to assess the extent to which sustainable goals are sufficient in the battle towards eliminating hunger by taking into account India's position in the global order.

## Introduction

### Achieving Zero Hunger: Sustainable Development Goal 2

In the following, the components of Sustainable Development Goal (SDG) 2 are given (United Nations Department of Economic and Social Affairs, 2016):

> 2.1 By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round
>
> 2.2 By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children less than 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons
>
> 2.3 By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment
>
> 2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality
>
> 2.5 By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including

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through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed

2.a Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance agricultural productive capacity in developing countries, in particular least developed countries

2.b Correct and prevent trade restrictions and distortions in world agricultural markets, including through the parallel elimination of all forms of agricultural export subsidies and all export measures with equivalent effect, in accordance with the mandate of the Doha Development Round

2.c Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility

**Contextualising Hunger and Food Security**

Ensuring global food security is not only a basic fundamental right, but one of the core foundational blocks vital to achieving SDGs outlined in the Agenda 2030 (Mihalache-O'Keef & Li, 2011). Centre stage in the roadmap to reaching sustainable development goals is SDG 2, achieving zero hunger. As outlined above, SDG 2 enumerates several sub-goals, which hint towards an integrated and multi-sectoral approach that encompasses socio-economic, political and cultural dimensions. The sub-goals are considerable steps towards an intersectional approach, drawing linkages between poverty, livelihood, health, and productivity in order to achieve food security. Achieving zero hunger is imperative and could act as a springboard to achieving other sustainable development goals as well such as health, gender empowerment and education.

However, food security is one of the gravest challenges facing the world today. As stated in the Food and Agriculture Association's (FAO, 2006) Food Security Policy brief, "of particular concern are hunger hotspots, marked by the widespread persistence and prevalence of food insecurity, especially in protracted crises" (p.2). In 2006, food emergencies requiring outside aid were present in twenty-five countries in Africa, eleven in Asia and the Near East, two in Latin America and one in Europe (FAO, 2006).

According to the Global Food Security Index, India ranks 75 amongst 113 countries in terms of food security and hence remains burdened with the highest number of undernourished and malnourished people in the world. Global estimates from the years 2014-16 reveal that 281 million people in the Southern Asian region suffer from hunger and malnutrition and, hence, this region carries the highest hunger burden in the world. The number of people with reduced access to food is estimated to rise to 2 billion by the end of 2050. In Asia alone, the number of people vulnerable to hunger is shockingly high, at 511.7 million (United Nations, n.d.)

The large-scale hunger and malnourishment prevalent in India elucidate the colossal figures stemming from Asia (Food and Agricultural Organisation (FAO),2016). India's performance in improving food security, infant mortality rates and stunting and malnourishment for children has been worse than some severely impoverished countries (United Nations & Research and Information System for Developing Countries, 2016). The criteria to identify food security, however, are not limited to the ones outlined above.

Identifying hunger criteria is crucial to its eradication. For example, Burchi et al. (2011) bring into light the aspect of "hidden hunger," which renders visible the lack of micronutrients in food-related aid programs which can bear long-term consequences on the physical and mental health of an individual. Phalkey et al. (2015) argue that "micronutrient deficiencies lower immunity and increase the risk of acquiring an infectious disease which in turn intensifies the problem of undernutrition, thus creating a vicious circle" (p. 2). The problem of hidden hunger is often ignored or rather less understood. This lack of understanding and research trickles into development programs catered towards eradicating hunger but failing to address the aspect of "hidden hunger." For example, food fortification programs have also come under criticism for adding nutrients to food in the "post processing period and not already integrating in the agriculture sector." (Burchi et al., 2011, p.364).

For a largely agricultural economy like India, it is pertinent to bring to the fore the issue of climate change that acts as a double burden for farmers who are already food insecure due to global price fluctuations as well as erratic weather patterns. Brown and Funk (2004) have established a range of factors that point towards food security as one of the gravest concerns under climate change. Brown and Funk (2008) predict "warming in Indian Ocean and an increasingly 'El-Nino like' climate

could reduce main-season precipitation across parts of Americas, Africa and Asia" (p. 580). These changing weather patterns also spell impending agricultural crisis for farmers. However reducing farmer's problems only to climate change would be doing a disservice to the role of food security. The key to agricultural crisis is rooted in removing international trade distortions and improving farmer support by extending technological know-how and creating a financial safety net. As has already been underlined above, eradication of hunger involves a holistic approach; one that is rooted in people's political, social and economic empowerment.

India in the Global Arena

Before narrowing the focus on India, it is important to zoom out and observe India's position in the global order, the role of globalisation, and international trade regulations and their impact on hunger.

**International Trade in the Era of Globalisation**

Analysing international political economy in the realm of globalisation is imperative to deciphering the power relations amidst countries existing within a closely knit system comprised of global financial institutions, multinational corporations, state institutions and the international social justice movements . The international order created by global financial institutions plays in favour of developed and financially powerful nations that dictate trade policies for developing countries, often putting the poor and vulnerable at risk of hunger and poverty. According to Krishnan and Subramaniam (2014), "these include providing heavy subsidies for production in rich countries, lowering trade barriers in developing nations for food commodity exports from developed countries, and pressuring poor countries into exporting crops" (p.105). The national governments in developing nations have to respond to the neoliberal forces in a global order by exerting more pressure on domestic natural resources otherwise viable to country's development There is an urgent need to recognise the surplus side of food as well as well as the unsustainable food consumption in developed countries, which is largely responsible for shrinking the rights of subsistence agriculture in the Global South (otherwise a valuable source for food security).

Mihalache-O'Keef and Li (2011) underline the impact of foreign direct investment in agriculture in countries like India. Modernisation theorists claim that foreign direct investment brings benefits to developing countries by equalising wages, development and prices between developing and industrialised countries. Dependency theorists, on the contrary, argue that foreign direct investment potentially destroys local markets and human capital in developing countries through unequal trade exchange. Primary sector foreign direct investment "hinders the type of rural development the FAO and UNCTAD recommend for alleviating hunger…Foreign investors in agriculture often expand by buying land from small farmers, preventing them from subsistence activities and forcing them to rely solely on wages too low for good nutrition" (Mihalache-O'Keef & Li, 2011, p.77). Foreign direct investment in the tertiary sector can lead to intensive migration to urban slums for jobs, further adding to the hunger burden and depriving farmers of the right to subsistence agriculture which otherwise could be a reliable source for their food production.

Although India hosts a large population of underfed and malnourished people, it is not immune to international pressures. The road to food security for India is not an easy one because it implies intervening in domestic food policies and foregoing international trade commitments, a step often met with resistance (Narayan, 2015). Formalisation of the 2013 National Food Security Act, one of the largest and most ambitious food security programs in the world, was a milestone for eradicating hunger in India. It proposed granting minimum support prices to farmers in addition to distribution of food grains at subsidized prices. Although the World Trade Organisation exerted pressure to stall this initiative, "Right to Food Campaign initiated in India played a major role in its actualization…The WTO has rules that regulate minimum support prices given to farmers. Sometimes these rules are resisted by local and national level social movements," like India's Right to Food Campaign (Krishnan & Subramanian, 2014, p. 107). Interestingly, Lindberg (1994) has observed mushrooming of small-scale farmer movements in India against a highly commercial agricultural economy since the beginning of 1970s. Hence it becomes pertinent to analyse the intersection between state and global institutions and local, national and international social movements to understand the terrain of food security.

Pingali (2007) notes, "FAO's study on Agriculture towards the year 2015/30 indicates that the trends in international trade of foodstuffs, which have seen developing countries from net exporters to net importers of food commodities, are expected to continue in the future" (p. 286). The FAO has found that an increase in food production for export in host countries can fuel a sharp decline in food and nutritional access for poor farmers who scarcely reap benefits from agricultural export, but are dependent on the same market for food access. Since 1965, researchers have revealed the damaging impact of trade and food aid on local food production in India, which has relatively decreased native production of domestic wheat. The devastating impact of subsidies, especially in low income countries, has sabotaged their


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food production capacity (Mittal & Krishnan, 1997).

**Nutritional Content and Westernisation of Food Patterns**

Aspects such as nutritional content and calorie intake are seldom highlighted while drafting measures for eradicating hunger. According to Guyomard et al. (2012) food waste is enormous since less than half of farmer-produced calories are utilised for human consumption due to lapses prevalent in the distribution system. It might be worthwhile to highlight this inconsistency and check into the cracks and fissures that exist in the food availability system to eliminate such deficiencies. Another factor that might be worth looking into is the Westernisation of food patterns that has sparked an ever-widening gap between producers and consumers.

Owing to rapidly increasing urbanization and a burgeoning middle class, Pingali (2007) has observed a dramatic shift in Asia towards Western diets, one that is increasingly diversified and commercialised. Asia has embarked on an irreversible track from traditional staple food diets towards diets including vegetables, oils and fats, dairy and meat products. The fast-paced transition to Western consumption patterns without sufficient infrastructural and research support is shrinking livelihood access for small farmers and harming soil quality. Arrival of new players such as multi-national corporations, food processers and the retail sector, who are blind to ground realities such as land rights and societal structures such as the caste system, have hit small farmers dependent on traditional agricultural systems (Guyomard et al., 2012).
Farmer Suicides in India

In a highly-acclaimed documentary Nero's Guests (Vehkalahti & Bhatia, 2005), Sainath, a renowned Indian journalist who has extensively covered farmer suicides, highlights the coercive agricultural policies and power wielded by state and international institutions that are inconsistent with sustainable means of crop production and increasingly drive small farmers out of work. Farming is largely becoming a unfeasible activity.

While around 60% of India's population is engaged in agricultural production, 50% of agricultural households are reeling in debt (Jitendra, 2014). The changing face of agriculture in India, along with farmer's incapability to keep pace with new trends, has prompted a sharp increase in farmer suicides in recent years. In other words, the recent technological innovations and commercialisation of agriculture has rendered the ancient methods of agriculture obsolete, which has further narrowed options for those who were entirely dependent on agriculture. Intensifying production of feed crops to support the vast increase in meat consumption has exerted significant pressure on food crop production for domestic consumption (Mohanty, 2005).

**India Within**

According to FAO (2014), India's performance in improving the hunger situation in the past two decades has been only marginal. Although food imports and domestic agricultural production has increased considerably, India has been unsuccessful in achieving food security. India remains one of the largest contributors to global levels of undernutrition. Due to tremendous challenges lying in the way to food security, it is worth taking into account India's financial and infrastructural preparedness to achieving SDGs outlined in Agenda 2030. A shortage of USD 8.5 trillion has been detected over a period of fifteen years required to achieve the mentioned goals. It remains to be seen whether India will fare well in achieving food security despite these resource shortages.
Land Degradation

Extensive soil erosion in India is a direct threat to agricultural productivity (United Nations, 2015). Increasing land degradation is a cause of worry considering a large portion of the Indian population still relies on agriculture for their livelihoods. Moreover, agricultural production is dominated by increased usage of chemical fertilisers extending over a long period of time that is not only harmful for the environment but in the long run, renders the land non-productive. Heavy metal and nitrate accumulation due to chemical fertilisers can lead to soil salinization (Savci, 2012). According to research conducted by the Indian Council of Agricultural Research in 2010, around 120 million hectares, almost equivalent to one third of India's land, is degraded (Vasudeva, 2015) Water and waste mismanagement, including the exponential increase in agrochemicals, is further degrading soil quality in India. Overuse of pesticides, coupled with their cheap and easy access, has magnified pest resistance, which initiates a vicious cycle of pesticide usage that leads to intensive soil degradation (Shetty, 2004).

Mohanty (2005) relates former British colonial practices with their long-term impact on land productivity and crop production. British colonial times witnessed large-scale cash crop production in India to support the then ongoing industrial revolution in Great Britain. Simultaneously, this practice strengthened the hands of powerful higher caste groups in India, who exercised influence and control over land reforms and agricultural produce. Continuation of such practices has decreased the rights

of lower castes, thus magnifying the extent of their desperation and problems. Drawing such linkages between the colonial past and the present challenges not only helps understand the issue of land degradation, but might provide answers to building future resilience.

**Food Availability and Distribution**

**Many millions of India's children are forced to spend much of their day on carrying water instead of going to school.**
Source: Balazs Gardi and Photo Credits Balazs Gardi (via flickr)

Regional differences often crop up in food distribution and availability mechanisms. The National Food Security Act, touted as the world's largest and most ambitious food security program, was introduced in 2013 to improve food security and distribution for the poorest of the poor in India. Not only did this scheme attempt to provide the food grains at subsidised prices for two thirds of India's population, but it also focussed on the nutritional status of women and children. Kulkarni (2010) highlights the lapses in the National Food Security Act and further underlines the myopic view that has long clouded the spectrum of food security. It fails to identify the target population and ignores qualitative aspects of food consumption that cover a broad spectrum between nutrition and calorie intake. Apart from such intrinsic problems, the public distribution system is subject to regional and social disparities.

According to the recent research conducted by Technology and Action for Rural Development (TARA, 2015), India has achieved success in creating rice and wheat surpluses; however, the food access and distribution system remains weak. The public distribution system is characterized by massive leakages and is rife with corruption in which a huge share of the food supply trickles down to middlemen (Krishnan & Subramaniam, 2014). Moreover it increases open market prices due to large purchases, thereby reducing purchasing power and food access for the poor (Dev, 2000). According to the Indian Council of Agricultural Research (2011), lapses occur within the agricultural marketing, which results in losses in the supply chain of 18 to 25%. Cash transfers have an inadequate impact when markets are underdeveloped and prone to price fluctuations (Kishore et al., 2014). Another less acknowledged but important aspect to note is that existing discrimination towards lower caste, ethnic or minority groups might further exclude them from food safety net programs (Kishore et al., 2015).

Lack of stable agricultural productivity stems from inadequate resources and market support provided to famers. Rising debts and lower incomes are primary characteristics of a neo-liberal world order where middle and lower income farmers find themselves sandwiched between aspirations and unfulfilled desires. While certain states in India have merely reduced the problem of hunger to crop failures, others have attributed the problem to loopholes that exist in agricultural productivity and marketing strategy. Due to a lack of technical knowledge and expertise, a large share of farmers have not been able to maintain pace with the ever-changing face of agricultural innovation (Mohanty, 2005).

**Lack of calorie and nutrition supplements in food programs**

Meenakshi (2016) outlines the "triple burden of malnutrition" in India, which encapsulates undernutrition, micronutrient deficiency and overnutrition issues. Lack of food security could lead to serious consequences in the health arena. Food security extends beyond quantity of food provided and should address nutrients needs. It is often directly equated to energy requirements, while nutritional requirements receive limited attention. Nutritional programs in India have weak implementation mechanisms. Regional differences have also been observed in addressing undernutrition, where states like Bihar and Uttar Pradesh have seen little improvement compared to Haryana and Maharashtra. According to the National Sample Survey Organisation, calorie intake for the poorest section of the population sums up to only 30 to 50% of that compared to the top quartile


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of the Indian population, even though the poorest section need higher calorie intake given that they frequently engage in manual labour (Saxena, n.d.). Due to high prices in the public distribution system, people tend to opt for tastier but less nutritious foods available in the market (Basu & Das, 2014). Cooking oil and pulses were not included in the public distribution system and the cash coupons could not compete with the inflated food prices. This is where food quality intake and diet diversification can play a central role in addressing the issue of hidden hunger.

Photo credit: Adam Cohn (via flickr)

**Slums, Mumbai**

## Gender-neutral or Gender-blind Approaches

Undernourished mothers tend to give birth to underweight children and malnourishment can also be transmitted to future generations (Meenakshi, 2016). Around one third to one fifth of children in India, predominantly in rural areas, are malnourished (Meenakshi, 2016) India lags behind Sub-Saharan countries in child nutritional status and child mortality rates (Narayan, 2015). Undernutrition has been observed largely amidst children whose mothers fall under a body mass index of 18.5 (United Nations, n.d.). Therefore, it might be essential to analyse the position of women, both in the household and society, to explore the crucial link between mother's health and its impact on children.

Oxfam India has supported research investigating the crucial link between nutritional status of families and women's empowerment (Dev & Sharma, 2010). Lack of maternal care can exert harmful consequences on child development. The number of Indian women suffering from anaemia between the age of 15 and 49 years is staggeringly high. More than half of women in this age group are estimated to be affected. Stunted growth has been observed among children under the age group of five and "around 48 per cent have low height for age and 42.5 per cent have low weight for age" (TARA, 2015, p.54). According to the Government of India, in 2009, "every three out of four children in India [were] anaemic and every second new born [had] reduced learning capacity due to iodine deficiency" (Dev & Sharma, 2010, p.22).

Distorted agricultural and food policies blind towards gender aspects can also be harmful towards women and children since the benefits often trickle down to male heads of households (Mittal & Krishna, 1997). Women are frequently also the worst hit in agriculture (Krishnaraj, 2006). Although women control almost all aspects of farm work, which includes sowing, weeding, planting and harvesting, they still struggle to be recognised as farmers. Gender discrimination runs deep on various levels: denial of land ownership and recognition of women as farmers has its roots in the dominant patriarchal framework in Indian society. (Singh & Lal, 2013). Diminishing access to sustainable livelihoods in the rural hinterlands of India has spurred outmigration of men to urban shores in search of jobs, which has further sparked an increase in the number of female-headed households. In a country where women are still struggling to be recognised as farmers and qualify as beneficiaries for farmer support, the sole burden of eking out an income to support the household has proven to be a major challenge.

## Impact of Climate Change and Natural Disasters on Food security

The relationship between climate change and food security is complex, though very crucial in understanding and solving food crisis. The impacts of climate change and natural disasters have raised formidable challenges for India's food security. Frequent droughts and prevalent water scarcity in large parts of India could lead to severe crisis, especially for regions highly dependent on groundwater irrigation. Recurrent natural disasters and erratic weather patterns could further erode livelihoods and pose a threat to farmers' access to food. The impact of climate change-induced health problems is well doc-

umented (Chakrabbarty, 2016).

## Way Forward

Achieving food security involves a holistic approach and is rooted in ensuring social, economic and environmental security and resilience. It requires a robust improvement in poverty reduction and health access. Enhancing human capabilities through social protection schemes can significantly contribute towards eradicating hunger (FAO, 2015b; 2016). For example, social protection efforts should improve purchasing power of the population through empowerment-generating schemes such as Mahatma Gandhi Rural Employment Guarantee scheme and Integrated Rural Development Program. Simultaneously, increased investments in research and infrastructure can spur innovative, resilient and sustainable growth in agriculture and food security.

## Trade and Food Security

The relationship between food security and trade reforms is rather complex. To better evaluate food security outcomes in a highly-integrated global market, it is imperative to assert that "international trade is neither a threat nor a panacea" (FAO, 2015a, p. 26). Therefore, its drastic impact on local markets and livelihoods should be incorporated in policymaking instruments in order to protect small farmers from falling into the hunger trap. A rather unfair competition exists between developing countries and those who dictate world market prices. While import subsidies are instrumental in reducing the price for consumers in food importing countries, they cause a significant problem for farmers who produce for export (FAO, 2016). Therefore international competition for domestic agriculture is a daunting challenge that must be addressed.

**A Dalit woman inspects a millet plant on a bio-diverse farm in southern India.**
Source: ucanews, Shawn Sebastian, Medak India February 25, 2016) (Photo Credits to D. Tejaswi)

## Supporting the Urban Food Basket

Urban agriculture is being considered a viable source to ensure food security at the community level. India hosts around 93 million slum dwellers and cities continue to swell due to urban sprawl. Prevalent hunger and food crisis in rural hinterlands will continue to trigger migration to urban areas (Ward, 2013). Although slums continue to be perceived as illegal settlements, deprived of basic amenities such as paved roads, sewage treatment, hospitals and schools, urban agriculture in these areas could extend food security to urban slum dwellers. Simultaneously, slum upgradation could be a significant driver to sustainable development and a secure future by keeping livelihood and food security central (Awasthi, 2013). For example, in Cuttack, slum dwellers have resorted to organic farming for personal nourishment and sell the surplus in local markets. Similarly, some areas in Mumbai's biggest slum, Dharavi, have been converted into community gardens. However, governments fail to notice the significant contribution made by urban famers as they remain under constant threat of displacement given the constant pressures of modernisation and infrastructure development. However promising, creating viable spaces for urban agriculture within crammed settlements remains a challenge (Redwood-Martinez, n.d.).

## Gender Sensitivity in Food and Agricultural Policies

Women's empowerment and access to livelihoods and financial security can yield significant gains in improving mal- and undernourishment in India. The strong position and decision-making power of women in the household and society can spell positive outcomes for India's food security. Grappling with challenges to eradicate hunger, India however continues to inspire the world with is effort towards the improvement of food security. The United Nations has honoured Vandana Shiva, a dedicated activist who has made significant contributions towards improving crop diversity in India. She initiated "Diverse Women for Diversity," a global movement to accentuate the key role women play in maintaining a healthy food system and biodiversity (United Nations, 2016).

## Developing Climate Change and Disaster Resilience

Another looming threat for global food security is climate change, requiring a new and innovative system


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that is based on resilience and better preparedness to cope with natural calamities (Brown & Funk, 2008). While climate change and resource shortages make small farmers vulnerable to crop failures, erratic weather patterns pose a big threat to sustainable agriculture (TARA, 2015). Adaptation to climate-resilient agriculture might involve some inexpensive measures that range from switching existing varieties to shifting crop periods; however, such transitions might also involve major investments and financial support. It is therefore essential to initiate a multisectoral approach that which involves government, the scientific community, and international organisations to work towards improving climate resilience in agriculture (Lobell et al., 2008).

## Facilitating New Technologies and Training Programs for Farmers

Education and training programs focusing on proper use of pesticides to avoid overuse and misuse are imperative to control pest resistance and soil degradation in the long run. Organic methods of food production as well as group farming for marginal and small farmers could be beneficial in reducing farmers' burden (Shetty, 2004). Reclaiming wastelands through eco-friendly techniques and training programs can facilitate the transition. Crop diversification is a means to explore other alternatives such as legumes and vegetables to supplement protein intake (Upadhyay & Palanivel, 2011).

## Road to Self Sufficiency

As Swaminathan has rightly outlined, what India needs now is an "evergreen revolution" (Bose, 2007). The problem of hunger is often equated to food shortfalls that can solely be mended with intensive crop production. For example, India is still reeling under the socioeconomic and ecological consequences that followed the Green Revolution (Mittal & Krishna, 1997). It is time to stop importing readymade solutions and consolidate local resources and skills to enhance food security. Achievement of food security should involve a healthy mix of improving technical competence coupled with stable food and agricultural policies as well as good governance to ensure stronger implementation (Bose, 2007). Reducing regional disparities, cross learning and knowledge sharing can also go a long way in improving food security.

If India is to achieve its target, it has to ensure strong implementation mechanisms in food distribution, gender-sensitive food policies, political will and improving intersectoral coordination between the concerned ministries (e.g., Ministry of Women and Child Development, Ministry of Health and family Welfare, Ministry of Agriculture and Ministry of Finance). For a diverse and vast country like India, need-based regional analysis and response is pertinent to improve food access. For example, different strategies such as cash coupons, food stamps, or in-kind food assistance might be key for different regions (Kishore et al., 2014). Anti-poverty programmes, including controlling food price inflation, should be coupled with improved health facilities in order to strengthen food security (Dev, 2000). As Fidel Castro, former President of Cuba, rightly said, "Hunger is the offspring of injustice and the unequal distribution of wealth in this world. What kind of magical solutions are we going to provide so that in 20 years from now there will be 400 million instead of 800 million starving people?...Let the truth prevail and not hypocrisy and deceit" (Mittal & Krishnan, 1997, p. 204). This statement has withstood the test of time and remains relevant today. If disparities within the national and international framework remain unaddressed, hunger and food insecurity will continue to manifest in certain parts of the world, including India, thus impeding the progress of sustainable development.

## Conflict of Interests

The author hereby declares that there is no conflict of interests.

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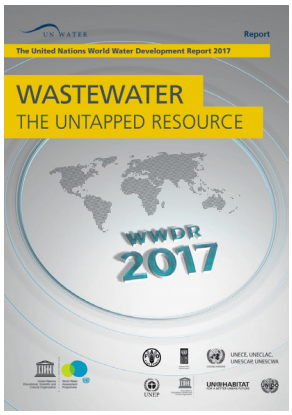


# The United Nations World Water Development Report 2017 Wastewater: The Untapped Resource

A book review by Permani Weerasekara

Published by United Nations Educational, Scientific and Cultural Organization(UNESCO)
Published year: 2017
ISBN: 978-92-3-100201-4

Presently in the world, fresh water is becoming a more important, yet more limited resource due to over-extraction, pollution and the effects of climate change. Therefore, the need for improved wastewater management is clear. Waste water is not just a water management problem. Waste water impacts the environment and all living beings, with consequences for human health, economic productivity and ecosystems. For the most part, human activities that use water end up producing wastewater. Thus, as the overall demand for water increases, the amount of wastewater also increases continuously worldwide. This report shows that improved wastewater management also entails the reduction of pollution at the source, the elimination of impurities in the sewers, the reuse of water, the recovery of useful by-products, and the potential use of wastewater as a sustainable resource. The 2017 edition of the United Nations World Water Report entitled "Wastewater: The Untapped Resource" shows how improving wastewater management offers social, environmental and economic benefits for sustainable development and is essential to the achievement of the 2030 Sustainable Development Goals (SGDs). This report is an excellent resource for students, policy makers, educators as well as researchers in the field of environment and sustainable management.

The demand for water is expected to grow significantly in the coming decades. In addition to the agricultural sector, which is responsible for 70% of the world's water use, a strong increase in water demand is expected for industrial and energy production. External factors that dictate future trends in water availability and quality will be the result of demographic dynamics and climate change. Climate change scenarios project a disturbance in the spatial and temporal dynamics of the water cycle, so that the meeting of water demand with supply is increasing challenging. The frequency and severity of flooding and droughts will also change around the world in many river areas. Additionally, the availability of water resources is also associated with water quality because water source pollution can prohibit several types of use. Increased releases of untreated sewage, combined with agricultural run-off and poorly treated industrial wastewater, have resulted in a deterioration of global water quality. Luckily, adequately treated wastewater is a resource that can be used to deal with water supply bottlenecks.

In this report, there are 18 chapters which discuss variable topics related to water, with a focus on wastewater issues, which has often been a neglected part of water management, receiving little social or political attention. The most important issues and challenges related to wastewater management are discussed, and the report highlights the importance of wastewater as a valuable resource, especially given water scarcity. Furthermore, this report discusses wastewater management under the Sustainable Development Agenda 2030, with a focus on efforts to promote synergies and address potential conflicts between the water target and other SDGs. Wastewater is directly addressed by SDG 6.3: “Improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally” (United Nations Department of Economic and Social Affairs, 2015).

Other topics of discussion are the basics of water management, including the many stakeholders and their different roles, legal and regulatory instruments, financial opportunities and challenges, as well as social, economic and cultural aspects. Wastewater presents a unique challenge because,



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in many cases, wastewater discharged without treatment affects persons that are geographically or temporally removed from the polluter. For this and other reasons, society must act collectively to manage wastewater, and thereby promote human health and protect water resources from pollution. Governance challenges relate to legal, institutional, financial, economic and cultural issues, but the benefits to society in dealing with wastewater are of great importance to public health and the environment. Overcoming practical difficulties in the implementation of water quality control can be especially difficult. To achieve the objectives of improving water quality and the protection of water resources, individuals and organizations responsible for various aspects of wastewater management must comply and act in the collective interest. The benefits are only realized once all rules are followed in order to protect water resources from contamination. In this regard, the technical aspects of wastewater management are a very important issue. The consequences of the release of untreated or poorly-treated wastewater can be categorized into three groups: adverse effects on human health, negative environmental impacts, and adverse effects on economic activities.

Wastewater from domestic sources is less likely to contain hazardous substances, although we must be aware of the problematic long-term effects that can result from low concentrations of pollutants, such as commonly used drugs. Rapid urbanization in developing countries leads to sudden increases in the production of municipal sewage, posing a great management challenge. Therefore current and future urbanization models need to be critically examined to develop more sustainable approaches to wastewater management in the coming decades. In terms of industrial wastewater, its toxicity, mobility, and concentration of pollutants are more important factors than the sheer volume of wastewater being produced. A remarkable opportunity for the recovery and recycling of industrial wastewater is the cooperation between plants to create a type of symbiosis regarding wastewater production and use. This is best seen in the eco-industrial parks which locate industries side by side in order to optimize the use of different streams of wastewater which can be recycled to produce useful by-products.

In addition, this report examined agricultural water pollution when fertilizers (nutrients) and other agrochemicals are applied more intensively than crops can absorb. Optimized irrigations systems can both decrease the amount of water use by increasing efficiency and simultaneously decrease the leaching of fertilizer nutrients into the groundwater. In addition to crop production, concentrated livestock production and aquaculture are major sources of nutrient pollution to water sources. Agriculture can be the source of several other types of pollutants, including organic matter, pathogens, metals, and agrochemicals. However, there is an opportunity for agriculture near urban areas to make use of municipal wastewater. In cases where municipal wastewater is properly treated and deemed safe, it can then be used as a free and valuable source of irrigation water to nearby agricultural fields, providing nutrients as well as the water that crops need to grow.

This report also explains the critical regional challenges for Africa, the Arab region, Asia and the Pacific, Europe and North America, Latin America and the Caribbean by making use of several case studies. In Africa, leaders must be persuaded that the "cost of inaction" regarding wastewater management is too great, negatively affecting the human health, environment, and development. While in high-income countries, 70% of wastewater is treated, only 8% is treated in low-income countries, creating a great problem for future generations.

Improved wastewater treatment, increased water reuse and the capture of useful by-products favor the transition to a recycling economy by helping to reduce water abstraction and the loss of resources that affect economic activities. Therefore, the world needs appropriate legal and regulatory frameworks and appropriate financing mechanisms to improve wastewater management. Creating proper financial and legal incentives for wastewater management will encourage investment in this area. Locally-adapted approaches to wastewater management are likely to be the most effective.

In conclusion, this report can successfully inform decision-makers, government, civil society and the private sector of the importance of wastewater management as a source of water, energy, nutrients and other recoverable and underestimated products.

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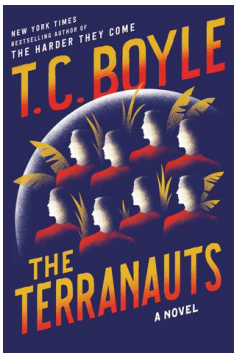


# The Terranauts

A book review by Sören Köpke

Author: T.C. Boyle
Book title: The Terranauts
Year of publication: 2016
Publisher: Ecco
ISBN-978-0062349408
Pages: 528

Why review a novel in an academic journal focused on food and agriculture? Because the very same themes, namely food production, agricultural efforts and ecological connections, loom large in T.C. Boyle's latest work The Terranauts. Boyle has long been interested in the interactions between human beings and the natural environment. First glances of this interest can be found in Budding Prospects (1984), a comical account of the challenges of growing Marijuana, but this theme really came to the fore in later works like A Friend of the Earth (2000) and When the Killing's Done (2011). The Southern California-based author has become a prolific writer on environmental themes, making his work a subject of study for the Environmental Humanities, an emerging academic field that approaches environmental topics through the methods and insights of the arts and humanities.

The Terranauts, set in the mid-1990s, takes many liberties in fictionalizing the real-life story of Biosphere 2 (called Ecosphere 2 in the novel). Biosphere 2 is a viviarium, a glass and steel construction in the Arizona desert that was designed to work as a closed ecological system. It consisted of five different biomes: a desert, an ocean, a mangrove marshland, a rainforest and cropland, as well as a human habitat. Beginning in 1991, the experimental, artificial ecosystem was staffed with a crew of people whose task was to survive in these self-sufficient earth-like surroundings. The long-term goal was to provide basic research for space colonization. The Biosphere 2 experiment marked the bold attempt to create a second ecosystem separated from earth – the ultimate hubris of technological invention. In reality, the project crashed through a combination of technological failure and human sabotage. T.C. Boyle decides to tell a slightly different story.

The story is told by three first-person narrators – two inside Ecosphere 2, one outside. This gives the narrative a good pace, making it enjoyable to read. T.C. Boyle's characters are ripe with flaws – cynicism, hypocrisy, self-loathing, betrayal, and loss of faith – which creates his trademark dark humor. The drama is amplified by the erotic tensions that characterize many group dynamics, especially under extreme situations: physical attraction, flings and affairs, passion and heartbreak.

Eight people – four women, four men – enter Ecosphere 2, each of them a specialist in his or her own field, be it rainforest ecology, oceanography, medicine, or animal husbandry. "Nothing in, nothing out", the "Terranauts" vow, for the entirety of the mission's two year duration. Thus, they inhabit a closed system in which they have to grow and prepare their own food, keep oxygen levels stable and monitor the interaction of species inside the glass dome. They milk goats, fish for Tilapia, slaughter a pig once in a while, and otherwise survive on a diet comprised of bananas, peanuts and sweet potatoes. The daily lives of the would-be space colonists are comprised of hard work in the fields and the animal pens. They unavoidably lose weight as they struggle to keep themselves and the system going. At a certain point, the Terranauts, half-starving for the sake of science, think only about calories.

Yet the system is not as closed as one might think, as the Ecospherians constantly communicate with the outside world, including countless phone calls and visits at the window by friends, lovers and relatives. This perhaps does not make it easier to endure the confined life inside the artificial ecosystem. "Mission Control", the controlling institution on


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the outside, tries to direct the course of the project as the Terranauts fight for a degree of autonomy while losing their group coherence in the process. There is a common, underlying motif also apparent in some of Boyle's other works, like Drop City (2003), The Road to Wellville (1993), or The Inner Circle (1993): what happens when a group of people, bound together by a strong and spellbinding, even utopian vision, is confronted with the contradictions of this vision? How do people react, as a group and as individuals, when the dream begins to shatter?

Ultimately, it is not the environmental conditions or the scarcity of food that endanger the success of the mission, as might be expected from the outset. Rather, group dynamics and the tensions between insiders and outsiders drive the slow-onset failure of the mission. A failure that is cleverly disguised through public relations. Yet what vibrates through the pages of the novel is a profound disillusion with any attempt to build an artificial environment, an otherworldly paradise.

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Sören Köpke is a doctoral candidate at University of Braunschweig, Institute of Technogy (TU Braunschweig) in Germany. He has earned an M.A. in Political Science, English and American Studies from Leibniz University, Hannover.

# Code of Survival – or the End of Genetic Engineering

A film review by Stephan Behrendt

Year: 2017
Producer: Bertram Verhaag
Production: DENKmal-Film Verhaag GmbH
Length: 95 min

Bertram Verhaag's latest documentary, Code of Survival - or the End of Genetic Engineering, is one of a series of significant international documentaries addressing the highly controversial debate about the risks and side effects of green genetic engineering. Verhaag already produced nine films in the past that were critical of genetic engineering. His tenth achievement presents examples of US agricultural systems after long-term use of genetically modified organisms (GMOs) and the associated pesticides on farm fields. He contrasts these GMO systems with three examples of long-time organic agriculture production systems around the world.

As new breeding technologies (NBTs) emerge, including "hidden" genetic engineering (like CRISPR/Cas9, TALEN, ZFN, etc.), our sensitive ecological and food systems worldwide are extremely endangered. In addition, there are doubts regarding the general safety of these crops. Christoph Then from the Institute for Independent Impact Assessment of Biotechnology points out, "We do not have the experience to declare these products safe. If these new techniques are not regulated, there will be no transparency, no choice for farmers and consumers as well as no possibility of safeguarding human health or protecting the environment […]" (Testbiotech, 2014).

In the beginning of the documentary, a contemporary US farmer refers to the transformation from traditional to modern agriculture. His main concerns are the change of generations and the global food supply. He has no reservations concerning new technologies, including GMOs. Even with all kinds of problems caused by extended use of genetically modified crops and associated pesticides, the farmer believes in the industrial approach. A quite similar perspective is shared by another US farmer shown later in this documentary. He has grown soy beans for a long time. Despite close contact with agribusiness and massive usage of the whole range of herbicides, he cannot control pigweed on his fields anymore. Occasionally, he must accept total losses. Nonetheless, there is no rethinking of the whole scheme.


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In between the interviews, one can see, on the one hand, scientific facts as well as critical statements aplenty. On the other hand, some foolish, GMO-friendly Youtube-clips are also embedded. A downplaying of the irreversible consequences of GMO- and pesticide-driven agricultural practices is displayed. This creates a slightly surreal atmosphere, which seems deeply disturbing and leaves behind a peculiar impression. These additions were perhaps superfluous for a serious documentary.

In contrast to modern US agriculture, the biodynamic SEKEM farm in Egypt is introduced as a first example of an environmental-friendly agroecosystem. Composting and humifying organic material enable symbiosis between living organisms and provide the basis for organic agriculture. Moreover, the principles of biodynamic farming are applied. The steadily growing SEKEM-community follows a holistic and sustainable approach.

The second example is the Indian AMBOOTIA tea plantation in the Darjeeling highlands, which is dealing with change to the local environment after converting from conventional to organic or, more precisely, biodynamic farming practices. Furthermore, the extensive organic tea production and the downstream processing are described.

The third example is an organic farm in Bavaria, Germany. Aunkofer's Biolandhof converted in the early 1980's from conventional to organic farming. Thus, the farm became one of the first organic farms in Germany. The farm combines sustainable pig farming with meaningful local waste processing. Usually, there is food-feed competition between livestock and humans. This issue can be avoided through utilization of organic waste and locally available grassland resources as staple feed in pig rearing. Moreover, animal welfare is a focal point on that farm.

The popular British researcher and pioneer of organic farming, Albert Howard, once said, "The health of soil, plant, animal and man is one and indivisible" (IFOAM, 2017). In a very impressive way, Code of Survival demonstrates the principles of organic farming (which include health, ecology, fairness, and care, according to the International Federation of Organic Agriculture Movements) and how it works around the world. In addition, the documentary shows an exemplary case in which there is successful revegetation of an overly harsh and hostile desert environment.

The documentary is comprised of more than a mere concatenation of generally known facts and accusatory words against GMOs. Successful, long-term alternatives to GMO production across three different countries are impressively visualised. The documentary uncovers the shortcomings of the destructive, one-way strategy of global agribusiness and contrasts it with diverse and sophisticated as well as location-adapted organic ways of farming. The advantages of sustainable organic farming are well-demonstrated and the clear superiority of organic farming in comparison with farming dictated by multinational agroindustry becomes apparent.

**"Nature is no play ground – Nature is the source of life!"**

Common welfare, including access to fresh water, healthy food, clean air, fertile soil and intact ecosystems, is essential for surviving on our unique planet. If we fail to recognise our past mistakes and if we do not switch our production behaviours and corresponding lifestyles towards an organic and sustainable approach, we cannot fulfil our obligation to provide care and safety to our descendants. We must undertake this responsibility for future generations.

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Stephan Behrendt is a doctoral candidate at University of Kassel, Department of Organic Food Quality and Food Culture in Witzenhausen / Germany. He studied Organic Agri-

culture with a focus on tropical and subtropical ecosystems under arid conditions.

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# Call for papers and analytical reports for Vol 6 Nr 1 (April 2018)

## Healthy ecosystems for/from sustainable agriculture

Our world is facing numerous problems today related to climate change and sustainable use of natural resources. Those challenges are endangering our planet and affecting every aspect of our lives. One of the most urgent problems is the rapid deterioration of agricultural ecosystems, which has heightened the need for knowledge regarding the management of healthy ecosystems. A healthy ecosystem can be described as a system that is sustainable, can maintain its structure and functions, and can resist external stress. Moreover, a healthy ecosystem provides innumerable services, such as soil maintenance, water purification, carbon storage and climate regulation. For sustainable development, the cohesive balance in the social-ecological systems is also important. Those services are highly important for the quality of air and water, and therefore the wellbeing of all people. Unfortunately, soil degradation by erosion, salinization, compaction, nutrient depletion or pollution has been rising since the 1950s. This degradation has reduced global agricultural productivity by 13% in the last 50 years.

On the other hand, unsustainable agricultural and aquaculture have considerable negative consequence to the ecosystem. The intensive application of chemical fertilizers and pesticides and the mismanagement of natural resources such as soil, water and forestry induce long term effects on climate conditions in many parts of the world. A healthy soil and water are vital parts of a healthy ecosystem. If the It is the key to productive agricultural ecosystems as it provides the medium for plant growth, serves as a habitat for many insects and other organisms, acts as a filtration system for surface water, and stores carbon. Restoring healthy agroecosystems and protecting the ecosystem through sustainable agriculture and aquaculture are therefore indispensable to nature protection, sustaining crop productivity, achieving food security and supporting the livelihoods of everyone.

The Future of Food Journal invites you to submit your research papers, reports or book reviews on this theme for publication in our Volume 6, Number 1 (April 2018).

The submission deadline is the **15th of February 2018**.

For more information about the submission guidelines:
*http://fofj.org/index.php/journal/about/submissions#authorGuidelines*

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Photos credits:- André T. (Background), Scott McCracken (Ecosystem), WorldFish (aquaculture), association GADEL Lot (Soil pollution), U.S. Department of Agriculture (USDA) (Seeding), ILO/N. Munkhbaatar 2014 (animal husbandry)

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The Department of Organic Food Quality and Food Culture at the University of Kassel, Germany and the Federation of German Scientists (VDW), Germany