The Contribution of Agro-ecology As a Solution to Hunger in the world: A review

ABSTRACT

Evidence from different studies has revealed a great contribution of agro-ecology in solving the world hunger sustainably. Agro-ecology addresses the problems and limitations of industrial agriculture such as inequalities, increased poverty and malnutrition rate, and environment degradation especially climate change; which are the roots causes of hunger in the world and hinder its eradication. In meeting these goals, agro-ecology raises the availability of food by augmenting yields considerably and increasing urban agriculture; it rises the accessibility of food by decreasing poverty; and upsurges the appropriateness of food by offering a food which is of high-quality nutritional, healthy and socially accepted or adopted. This farming system also contributes to water security and to the respect of the right to water and hygiene by lessening the pressure on water resources, growing the flexibility to water shortage and diminishing the frequency of battles among conflicting water uses; and therefore, enhances food security and the apprehension of the right to adequate food. Agro-ecology contributes in conserving biodiversity and natural resources, in increasing resilience to climate change and combating the extenuation challenge, in growing control of peasants upon agricultural and food systems, and in empowering Women as well.

Key words: agro-ecology, industrial agriculture, food security, food sovereignty, hunger.

1. INTRODUCTION

Today's dominant industrial food and agricultural system is speedily diminishing and degrading the soil, water and biodiversity of the world; escalating climate disturbance; combining wealth and supremacy above food-related resources; and quickening the poverty and hunger of the world (Cook, Hamerschlag and Klein, 2016; FAO, 2016). A recent FAO study estimates that about 795 million people are still suffering from hunger in the world (FAO, IFAD, and WFP, 2015; Pinstrup-Anderson et al., 1999; Uphoff, 2002; FAO, 2000). In addition to hunger, there is also the burden of under nutrition. Yet, eradicating hunger universally is one of the greatest challenges of the humanity in the 21st century (Lomborg, 2004). However, there are completely contradictory visions for how to achieve this goal. Many people associate nourishing the world with the need to produce additional food, but this analysis leaves essential facts about the world hunger out of the picture. In fact, the order or education to produce extra food to nourish the world is frequently raised up to defend food and farming policies and practices that worsen the conditions of hunger and weaken our capacity to nourish future generations (Office of Technology Assessment, 1992; Cook, Hamerschlag and Klein, 2016). Feeding the world sustainably obliges that we safeguard the ecological resources that are indispensable for generating food currently and in the future. Evidence show that agro-ecological farming, comprising diversified organic agriculture, is the furthermost effective agricultural answer to the challenges of the environment that impend our forthcoming food security such as climate change, soil loss or erosion, water shortage and damage of biodiversity (Pretty et al., 2000; Wood et al., 2000; McNeely and Scherr, 2001). Additionally, research regularly proves that world hunger is not principally a problem of global supply of food, but somewhat of poverty, nonexistence of democracy and uneven access to land, water, other resources and infrastructure, particularly for women. Rather than only generating extra food in imbalanced conditions, the solution to hunger centers on forming further democratic and nondiscriminatory political and economic systems that magnify access to resources (Cook, Hamerschlag and Klein, 2016). Thus, agro-ecology addresses the social and economic drivers

of continuing hunger underwent by around 800 million people all over the world as a systemic method to food and farming (SDSN, 2013). It is a essential pillar of food autonomy while enhancing the democratic control of our food production and challenging corporate power in our food system in order to fight poverty, inequality/discrimination and hunger (De Schutter, 2010a). Therefore, this article aims at demonstrating the contribution of agro-ecology as a solution to solving the world hunger.

2. METHODOLOGY

This paper analyses and summarizes the key findings reported by various authors in the domain of agro-ecology and uses existing database and data to illustrate the contribution of agro-ecology as a solution to solving the world hunger. Most of the reviewed papers were obtained from published articles and reports and covered existing literature and results related to food insecurity, hunger/ malnutrition and poverty; to reasons of why industrial agriculture is no longer viable; agro-ecology as a solution in resolving the world hunger; and to promotion and adoption of agro-ecological approaches.

3. FOOD INSECURITY, HUNGER/MALNUTRITION AND POVERTY

What is food security?

In contrast to the objective of the green revolution to make food available at stable prices in both national and international markets by increasing the production, the food security was not achieved. Only one factor of the latter was considered yet Food security exists when all people have a physical, social and economic access to adequate, harmless and nutritive food, at all time, which meets their nutritional requirements and food favorites for an active and healthy life (Parmentier, 2014). Therefore, all the four key elements or factors of food security such as: availability, access, utilization and stability are considered (World Food Summit, 1996).

Food availability

This means the availability of adequate amounts of food in appropriate quality, supplied via national production or imports, comprising food aid (Parmentier, 2014).

Food access

It is the access to sufficient resources for obtaining suitable foods for a nutritious food by individuals taking into account all commodity packages over which a person can found command on resources, given the legal, political, economic and social provisions of the community in which s/he lives, comprising traditional rights such as access to shared resources (World Food Summit, 1996; Parmentier, 2014).

Utilization

It implies the utilization of food via adequate regime, uncontaminated water, cleanliness and health care to arrive to a nutritious comfort where all the physiological requirements are met.

Stability

This means also that a population, household or individual have access to sufficient food at every time. This stability must remain even when there are sudden shocks such as economic or climatic crises, or repeated events such as agricultural seasons. It is needed for both availability and access to food (Parmentier, 2014).

Relation between Food Insecurity, Hunger/ malnutrition and Poverty

These three or two concepts are related to food insecurity. Hunger is assumed to be a scratchy or painful sensation initiated by inadequate food energy consumption (World Food Summit, 1996). This concept is referred to, scientifically, as food deprivation. It is an outcome of food insecurity, which in turn, is often caused by poverty. Understanding hunger and its causes needs the identification of the necessary conditions or factors for food security (World Food Summit, 2002) according to its definition by World Food Summit (1996): All the people who are hungry are food insecure, but not all the people who are food insecure are hungry since there are other causes of food insecurity such as the poor consumption of micro-nutrients (World Food Summit, 1996). Also, famines, hunger and malnutrition are related less to declines in food availability than to people's access to food according to Amartya Sen, (1981). He (1981) demonstrated that famines in different countries (e.g. Bengal, Ethiopia and Bangladesh) were not caused by food availability decline but by factors such as falling wages, rising food prices, loss of employment and declining livestock prices which relate all to food access and markets. Therefore, although food is available in today's environment, many households cannot afford the same quantity and quality as before, because incomes have not been kept up with prices. In addition, the failure to grow anything due to natural disaster such as drought or salinity in some areas (sub-Saharan African and Asian countries), for example, does not affect hunger as much as people lack of means to access to food because, if enough means are available, they can still buy food and satisfy their needs (FAO, 2015). Similarly, although malnutrition is a result from insufficiencies, excesses or disproportions in the intake of macro- and/or micronutrients, it is an outcome of food insecurity and may relate to non-food factors such as: poor care practices for children, inadequate health services; and a harmful or unhealthy environment (World Food Summit, 1996). Consequently, poverty is among the main causes of hunger. It comprises different scopes of deprivation that relate to human abilities including intake and food security, health, education, privileges or rights, opinion, security, self-respect/esteem or dignity and decent work. The absence of sufficient and suitable nutrition itself is one of the underlying causes of poverty (World Food Summit, 1996). To resolve the problem of food insecurity, poverty and hunger; a combination of income growth supported by direct nutrition interventions and investment in water, health and education as well as good policies advocating against inequalities and involvement of everybody in decision making/taking are needed (FAO, 2008; FAO, 2013).

Prevalence of Undernourishment in the World (PoU)

The most current PoU estimates show that the share of undernourished people in the world decreased from 14.7 percent in 2000 to 10.8 percent in 2013, despite significant population growth. However, this reduction has recently slowed considerably by coming to a virtual standstill between 2013 and 2015. FAO estimates for 2016 indicate that the global prevalence of undernourishment in 2016 may have actually risen to 11 percent, implying a return to the level reached in 2012 and suggesting a possible reversal of the descending trend sustained over recent decades. The latter situation is most worrying.

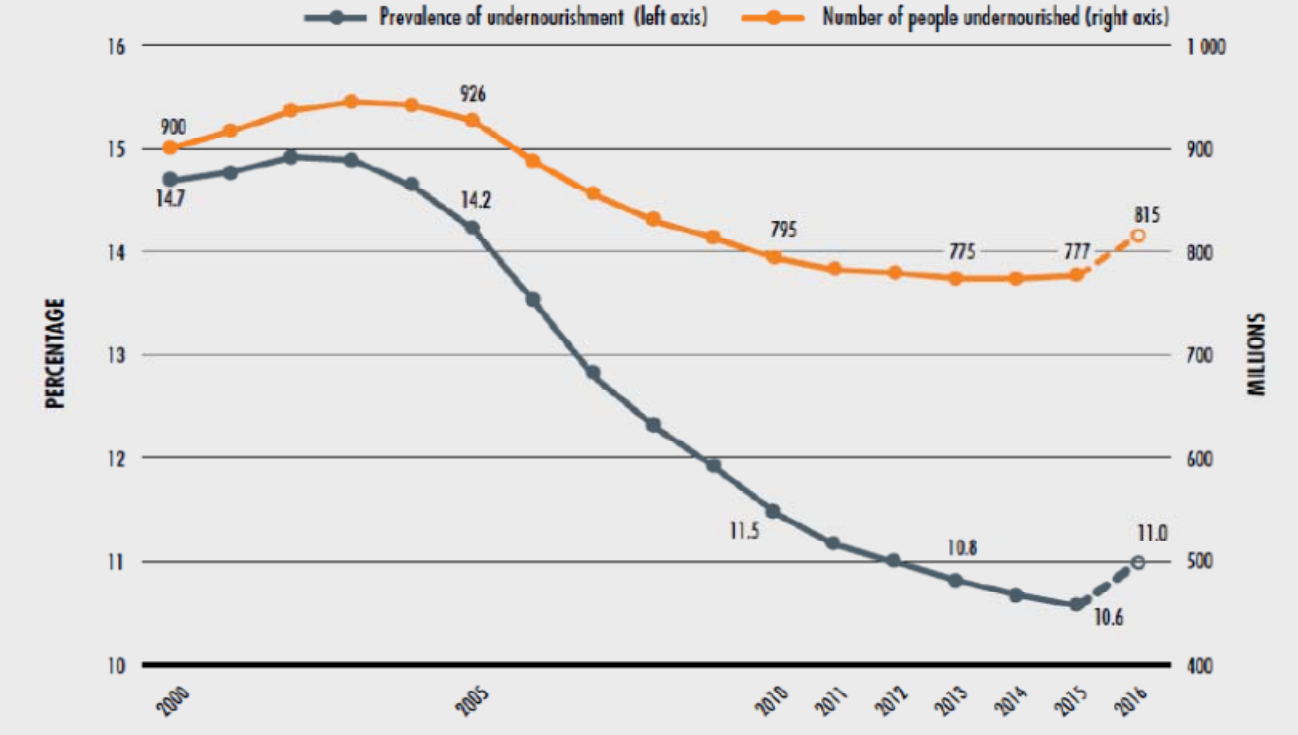

Figure.1. General Prevalence of Undernourished in the World
(Source FAO, 2016)

Prevalence of Undernourishment in the World by Region, 2000-2016

The progress continues in the fight against hunger, yet an unacceptably large number of people still lack the food they need for an active and healthy life.

	2000	2005	2010	2011	2012	2013	2014	2015	2016[1]
	Percentage								
WORLD	**14.7**	**14.2**	**11.5**	**11.2**	**11.0**	**10.8**	**10.7**	**10.6**	**11.0**
AFRICA	**24.3**	**20.8**	**18.3**	**17.9**	**17.8**	**17.8**	**18.1**	**18.5**	**20.0**
Northern Africa	**6.8**	**6.3**	**5.1**	**4.8**	**8.5**	**8.4**	**8.3**	**8.3**	**8.3**
Sub-Saharan Africa	**28.1**	**23.7**	**20.6**	**20.2**	**20.0**	**20.0**	**20.4**	**20.8**	**22.7**
Eastern Africa	39.3	34.3	30.9	30.2	30.6	30.6	30.9	31.1	33.9
Middle Africa	37.4	29.4	23.8	23.1	22.5	22.3	24.0	24.4	25.8
Southern Africa	7.1	6.4	6.7	6.3	6.2	6.2	6.5	6.6	8.0
Western Africa	15.1	12.0	10.0	9.9	9.9	9.8	9.8	10.4	11.5
ASIA	**16.7**	**17.0**	**13.2**	**12.8**	**12.5**	**12.2**	**11.9**	**11.6**	**11.7**
Central Asia and Southern Asia	**17.6**	**20.1**	**15.7**	**15.7**	**15.6**	**15.4**	**15.1**	**14.7**	**14.2**
Central Asia	15.7	14.2	10.6	9.9	9.1	8.4	8.2	8.2	8.4
Southern Asia	17.7	20.4	15.9	15.9	15.9	15.7	15.3	14.9	14.4
Eastern Asia and South-Eastern Asia	**16.6**	**15.2**	**11.6**	**10.9**	**10.4**	**9.9**	**9.6**	**9.2**	**9.7**
Eastern Asia	14.6	14.1	11.3	10.7	10.3	9.9	9.5	9.1	9.0
South-Eastern Asia	22.0	18.1	12.4	11.3	10.7	10.0	9.7	9.4	11.5
Western Asia	**11.3**	**10.5**	**9.4**	**9.1**	**8.9**	**8.7**	**8.9**	**9.3**	**10.6**
LATIN AMERICA AND THE CARIBBEAN	**12.0**	**9.1**	**6.8**	**6.6**	**6.4**	**6.3**	**6.3**	**6.3**	**6.6**
Latin America	**11.1**	**8.0**	**5.9**	**5.7**	**5.5**	**5.4**	**5.4**	**5.5**	**5.9**
Central America	8.1	8.3	7.1	7.2	7.1	7.1	6.9	6.7	6.5
South America	12.2	7.9	5.4	5.1	4.8	4.7	4.8	5.0	5.6
Caribbean	**23.8**	**23.3**	**19.9**	**19.3**	**19.4**	**19.2**	**18.9**	**18.4**	**17.7**
OCEANIA	**5.3**	**5.3**	**5.0**	**5.2**	**5.3**	**5.7**	**6.0**	**6.4**	**6.8**
NORTHERN AMERICA AND EUROPE	**< 2.5**	**< 2.5**	**< 2.5**	**< 2.5**	**< 2.5**	**< 2.5**	**< 2.5**	**< 2.5**	**< 2.5**
Other country group:									
Western Asia and Northern Africa	9.3	8.7	7.6	7.3	8.7	8.5	8.6	8.8	9.5

Figure. 2. Prevalence of Undernourished by Region in the World
(Source FAO, 2013)

The total number of people affected by chronic food deprivation in the world began to increase during 2014 moving from 775 million of people to 777 million of people during 2015 (Gaiha, 2018) and has now increased to 815 million in 2016 according to current estimates (FAO, 2017; UNICEF, 2017; WFP, 2017). The global average of the PoU has stagnated from 2013 to 2015 as a result of two counterbalancing changes at the regional level: the share of undernourished people in sub-Saharan Africa increased, while it declined in the same period in Asia. But, the PoU has augmented in furthermost regions excluding Northern Africa, Southern Asia, Eastern Asia, Central America and the Caribbean in 2016. The worsening was most severe in sub-Saharan Africa and South-Eastern Asia. The Sub-Saharan Africa also remains the region with the highest PoU, affecting an alarming 22.7 percent of the population in 2016. The situation is particularly urgent in Eastern Africa, where one-third of the population is estimated to be undernourished; the sub region's PoU increased from 31.1 percent in 2015 to 33.9 percent in 2016. A high PoU continues to be shown in the Caribbean (with 17.7 percent) and Asia (with 11.7 total percent with peaks of 14.4 percent in Southern Asia). The most visible uptick in undernourishment was in South-Eastern Asia, increasing from 9.4 percent to 11.5 percent from 2015 to 2016, to return to near levels reached in 2011 in Asia region. But, levels remain low in Latin America, especially in South America, where the PoU climbed from the percentage of 5 during 2015 to the percentage of 5.6 during 2016. The uppermost number of underfed people in the

world is in Asia due to the size of its population. According to FAO estimates, in 2016, almost 520 million people in Asia, more than 243 million in Africa, and more than 42 million people living in the Latin America and in the Caribbean do not have access to adequate food energy. The recent increase in the prevalence of undernourishment can be attributed to a variety of factors such as: recent reductions in food availability and increases in food prices in regions affected by El Niño / La Niña-related phenomena notably; in Eastern and Southern Africa and in South-Eastern Asia mostly. Furthermore, the number of conflicts has increased in the past years particularly in countries already facing high food insecurity and with much of the related violence.

4. WHY INDUSTRIALISED AGRICULTURE IS NO LONGER FEASIBLE?

The spread of industrialized agriculture has significantly contributed to the increases of food production over the past years (Koohafkan, 2011). The green revolution of agriculture doubled the production of cereal in several parts of the world through the usage of improved seeds varieties during the 1980s and 1990s (IFAD, 2010; Altieri et al., 2012b). This increment in the yields reduced poverty, food insecurity and malnutrition to some extent. Also, this increment, contributed to pull down the prices of cereal, thus profiting to poor consumers i.e. higher calorie availability, less malnourished children (Hazel, 2003; IFAD, 2010). However, there is as well existing evidence demonstrating that the industrialization of agricultural has contributed considerably to exacerbate the levels of poverty, hunger and malnutrition by increasing inequalities among farmers and economic debt or the rural migration (Parmentier, 2014; Mazoyer, 2008; Utviklingsfondet, 2011; McKay, 2012). The Green Revolution (i.e. agricultural intensification) failed to guarantee a harmless and ample food production for all people and assumed that ample water and low-cost energy to fuel the modern agriculture will always be available; that climate will be stable and will not change. Yet; the agrochemicals, the fuel based mechanization and the irrigation processes are derived from declining and ever more expensive fossil fuels; climate extremes are becoming more frequent and violent, and the threaten genetically homogeneous modern monocultures is currently covering 80 percent of the 1500 million of Hectares of the universal arable land. Moreover, industrial agriculture contributes 25 to 30% of Green House Gas emissions, altering weather patterns hence compromising the capacity of the world to produce food in upcoming future. In consequence, industrialized agriculture has been accountable for the main social and environmental costs during the past five decades that there is a growing need to move to a much more sustainable farming paradigm (Parmentier, 2014; De Schutter and Vanloqueren, 2011; Koohafkan, 2011; McKay, 2012). Similarly, industrialized agricultural model cannot permit the world to nourish itself now and in the upcoming in the context of climate change and energy scarcity while there is a resource constrained world (IAASTD, 2009; Parmentier, 2014; Altieri and Toledo, 2011; De Schutter and Vanloqueren, 2011; Utviklingsfondet, 2011).

Ecological footprint of Industrial agriculture

The increasing rate in cereal yields is decreasing in some of the main areas of grain production of the world as real crop yields approach an upper limit for maximal yield potential. Furthermore; serious interrogations about the social, economic and environmental sustainability of the modern farming approaches are rising when the petroleum dependency and the ecological footprint of industrialized agriculture are accounted for. The intensification of agriculture by the usage of high yielding varieties of crops, fertilization, irrigation and the use of pesticides effect severely on natural resources with grave health and environmental consequences (Altieri et al., 2012).

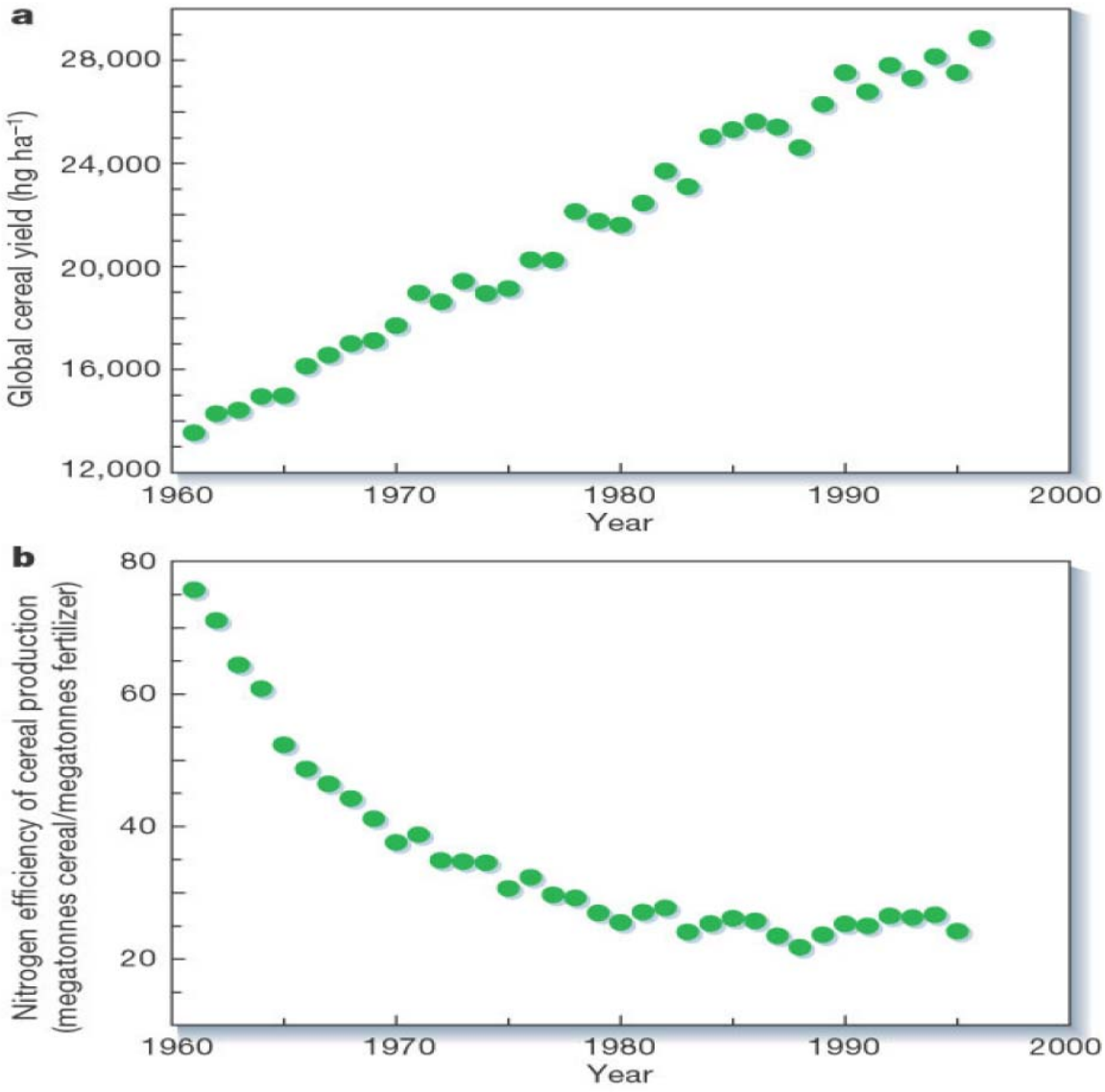

Figure. 3. Ecological Footprint of Industrial Agriculture
(Source Altieri, 2012)

The external costs of UK agriculture is estimated to be at least 1.5 to 2 billion Pounds every year and to approximately 13 billion of Pounds each year in the US amount, getting up from destruction to water resources, soils, air, wildlife and biodiversity, and harm to human health/wellbeing. Additionally, the annual costs of USD 3.7 billion increase from agency charges linked with programs to address these difficulties or/and encourage a shift to more sustainable systems. Therefore, the US arrogance about cheap food is a delusion because consumers pay for healthy food beyond the grocery store. Also, monocultures are heavily dependent on pesticides due to the lack of ecological regulation mechanisms. The usage of pesticides has augmented intensely in the world in the past 50 years and has now reached 2, 6 million of tons of pesticides each year with a yearly value of more than US$ 25 billion in the global market (Lichtfouse, 2012). This increment in pesticides use has result into indirect environmental impacts and social costs reaching around $8 billion every year. In this regard, a total of 540 species of arthropods have become resistant against more than thousand different types of pesticides. As a consequence, those pests can no longer be controlled by those chemicals.

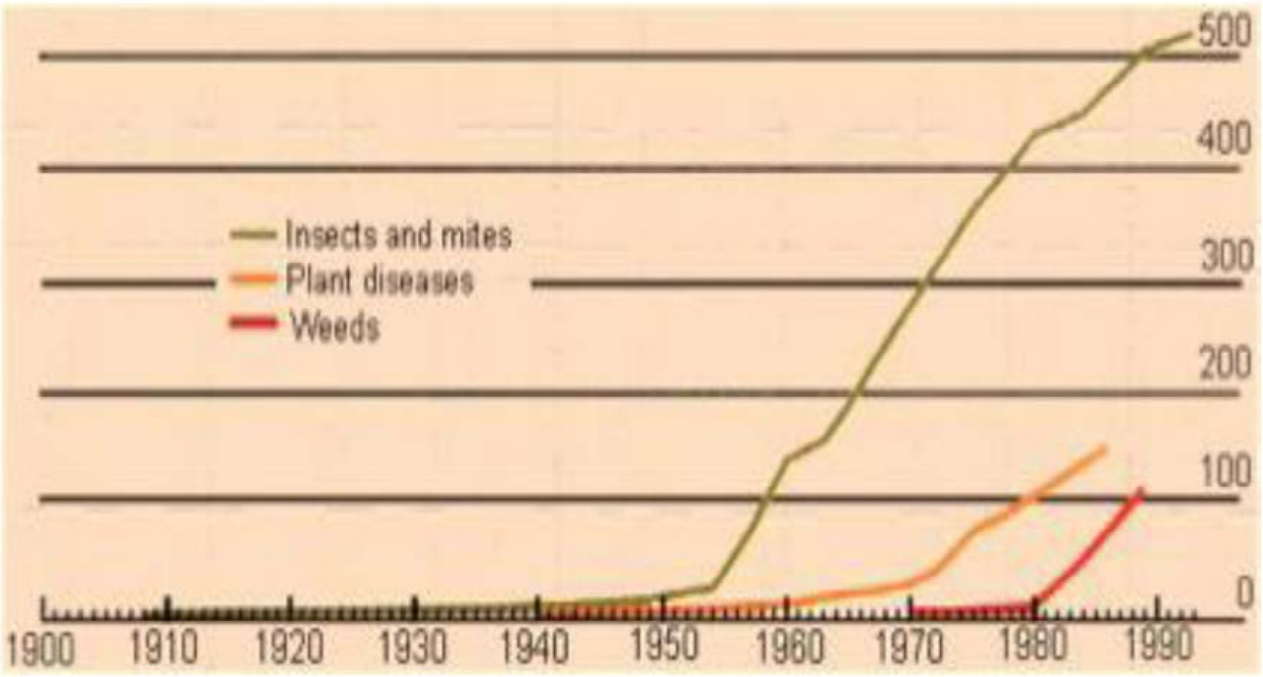

Figure. 4. The rapid resistance development by insects, pathogens and weeds to pesticides
(Source Altieri, 2012)

Agribusiness and World Hunger

Currently there are almost 1 billion of hungry persons in the world (World Bank, 2016; FAO, 2015). This hunger is caused by poverty (due to very little earning) and inequalities (none access to land, seeds, capital, unequal distribution, priorities etc.) but not necessary by less production (FAO, 2017; 2015; 2002). The world production is already enough to feed the increasing population in coming years. Nonetheless, the greater part of industrially production goes to biofuels and limited animals. Therefore, the need to increase production is justified by the prioritization of the rising livestock population and automobiles over hungry people. Industrialized agriculture considers high yields and total food supply as its potential to lessen hunger. Yet, it has agreed that yields are necessary but not sufficient condition to meet the food needs of people (Lappe et al., 1998): 78 percent of all malnourished children fewer than five years are in countries with food excesses. The food supply is not a crucial factor of hunger reduction (already abundant food but hunger continues to grow) but food distribution i.e. to ensure if people have sufficient rights or power on land, income and have provision networks to protect a food which is healthy (WFP, 2017; FAO, 2017). By weakening prices and abolishing the economic viability of local farming systems, farmers are incapable to sell their products in a manner that permits them to cover the costs for example. Thus food will deteriorate in the fields whereas people are hungry (Holt Gimenez and Patel, 2009). Also, approximately 1/3 of food production (i.e. around 1.3 billion tons per year) is wasted generally, amounts which, can feed the entire African continent. The big amount of wasted food is in Europe and North America.

The Global Food Production Concentration

The industrial agriculture accelerates the concentration of land and resource in the hands of a few and, therefore, weakens the possibility of addressing the root causes of hunger. This concentration of the global food production underneath the control of a few has created food trade disparities and import reliance which cause the increasing food insecurity in several countries. Food self- sufficiency can be undermined and the local ecosystems threaten by cash crop exports production in exchange for food imports and the enlargement of biofuels. This situation is being worsen by food insecure

governments such as South Korea , China and Saudi Arabia which depend on the imports to nourish their population and which are grabbing up huge areas of farmland (more than 80 million hectares already transacted) overseas to satisfy their offshore food production. In addition, the investment in foreign farmland is seen as a significant novel source of revenue gained from the production of biomass (Magdoff et al., 2000; Pimbert et al., 2010). In Uganda as in most Sub-Saharan African countries and other parts in the world (OXFAM, 2016; 2013), land grabbing is leaving most of smallholder farmers with less land (even displaced) at the expense of large scale farmers or powerful individuals who, even sometime, acquire land illegally to grow crops needed for industrialization and commercialization (international level) such as coffee than growing staple food crops which are consumed domestically or traded within the region.

5. AGRO-ECOLOGY AS A SOLUTION IN SOLVING THE WORLD HUNGER

What and Why Agro-ecology?

Different actors define agro-ecology differently (Wezel et al., 2009). Some researchers define agro-ecology as the discipline or science which seeks out the understanding of the inner working of agricultural ecosystems and including a portion of the human component (Carroll et al., 1990; Altieri, 1995, Gliessman, 2007). It implies agricultural approaches which are based on the use of principles which are haggard from biology for agro-ecology practitioners (e.g. increasing the recycling of biomass, assuring favorable soil conditions, minimizing the losses of nutrient from the system, raising up the functional biodiversity of the system and raising up the improved biological interactions and synergisms) (Altieri, 1995; 2002; 2004). By applying the former principles, agro-ecology improves agricultural systems by imitating natural processes and then, augmenting the biological interactions which are beneficial while enhancing the synergies between the components of the agro-biodiversity. Agro-ecology is extremely knowledge intensive developed via farmers' knowledge and experimentation. It allows and requires diversification of tasks on the farm, and emphasis on smallholder farmers who cover the major number of the rural poor and ameliorate its conditions by stabilizing the yields and enhancing food security ((Pretty, 2008; Altieri, et al., 2012). The agro-ecological agriculture possess significant advantages compared to industrialized agriculture for people and for the earth (Rosset, 2015; IAASTD, 2008; De Schutter, 2011). The most significant include the production of adequate and healthy food for locally living people (food autonomy or sovereignty), better rural source of revenue/livelihoods and cultures, flexibility to climate change and other shocks, lower greenhouse gas emissions, lower production costs or less indebtedness, better management of productive resources and biodiversity and, greater autonomy and less external dependence.

The Production of Adequate and Healthy Food for Locally-Living People

Many recent studies have shown that small farms are further productive than big ones (Rosset, 2015; Rosset, 1999); and agro-ecological systems are equally productive, and in many circumstances, further productive compared to the monocultures system which are chemical-dependent (Badgley et al., 2007; Rosset, 2015; Pretty and Hine, 2001; Pretty et al., 2003; De Schutter, 2011). Integrated agro-ecological systems on small farms are the systems which are most productive when it comes to unit per area (Rosset et al., 2011; Rosset, 2015; Machín Sosa, et al., 2013).

The Rural Livings and Cultures

Agro-ecology helps to preserve and strengthen rural people livelihoods and to conserve and enhance rural cultural by helping rural-living people to possess access to land and to other factors of production , and favoring them as producers of food for markets at local and national levels (Rosset, 1999).

The Resilience to Climate Change and Other Shocks

The agro-ecological agricultural systems are much diversified and consequently, they are faraway more resistant and resilient when they are confronted with climate shocks and others (Rosset et al., 2011; Altieri and Koohafkan, 2008).

The Lesser Emissions of Greenhouse Gas

The food system which is more localized and based on agro-ecological small farms which is producing for local and national markets is likely to considerably reduce the emissions of GHG (Vandermeer et al., 2009; LVC, 2009).

The Lesser costs of production, the fewer Indebtedness

Agro-ecological systems reduce considerably production costs and farmer indebtedness because they use the on-farm inputs and the synergies available which are in the integrated systems (Rosset et al., 2011; Rosset and Martínez-Torres, 2012).

The Productive Resources and Biodiversity Better Stewardship

The small farmers that practice traditional or agro-ecological farming are greatly better agents of productive resources and of functional biodiversity such as the genetic resources of crops (Jarvis et al., 2011; Rosset, 1999).

The Bigger Sovereignty and Fewer Outside Dependency

Agro-ecology can help peasants and family farmers to build the relative independence/autonomy from the credit, input and the global output markets which function on nonefavorable terms for them (van der Ploeg, 2008; 2010; Rosset and Martínez- Torres, 2012).

The Contribution of Agro-ecology in Solving World Hunger

Research has demonstrated that world famine is not mainly a problem of the overall supply of food, but somewhat of poverty, nonexistence of democracy and uneven access to land, water and other resources and infrastructure, particularly for women. For instance, traditional societal structures often track men and women into different parts of the chain, and women are typically directed into activities that receive lower remuneration (Christian et al., 2013). These divisions have impacts when it comes to income, access to land and the ability to have a voice in the decision making process of rural communities. For example, female agricultural workers in India are more likely than men to find themselves performing casual labor (World Bank, 2008). Women are disproportionately represented in the landless rural population who face food insecurity and inability to meet basic needs (Oxfam, 2013). They are disproportionately the victims of land grabs by large corporations. Further, land tenure laws often restrict their access to land or the ability to participate in the decision making process regarding land use (Staritz & Reis, 2013). Similarly in Uganda, socio-cultural norms limit women's access to land as well as in income generating activities which increases their poverty and food insecurity and hunger as well (OXFAM, 2016). In addition, much of agricultural production in the world is not dedicated to nourishing people. In the U.S., for example, 36 percent of all slush is used to nourish livestock, another 40 percent is used as biofuels. This situation means that huge quantities of farmland which might produce a variety of nutritious foods are locked up in livestock feeding and fuel production. These trends are replicated universally such that almost 1/3 of grain produced in the world are converted into animal feed while 17 percent are dedicated to ethanol and other biofuels. This dedication of land and food crops to biofuel production is primarily harmful because it increases the prices of food and turns away land and other resources from production of food (World Food Program, 2000). Lastly, about 1/3 of the food, which is worldwide produced, is lost as waste and to spoilage or is left in the field. To resolve world hunger we, therefore, need agro-ecological farming which enables strategies and programs which make democratic the accessibility to food, arable land, water, fair markets and credit; especially for women. Agro-ecological solutions to hunger pivots on creating systems which are more democratic and fair political and economic and which expand the access to resources. Agro-ecology is a central pillar of food sovereignty. It increases the democratic control of our food production and challenges the corporate power in our food system in order to fight poverty, inequality and hunger. This approach helps to address hunger and poverty sustainably because allows expanding public investments to the small producers of food who produce more than 90 % of all farmers in the world and who deliver more than 80 % of the consumed food in much of the developing world, mainly Southern Asia and sub-Saharan Africa. Raising the ability of small farmers to nourish themselves and to nourish their communities is central to food security and poverty reduction, especially for more than one billion of poor rural people in the world (Edelman, 2014). Agro-

ecology approach also helps addressing hunger and poverty by reducing global food waste and shifting consumption towards plant-based foods and getting away from growing food for livestock nourishment and biofuels. Thus, agro-ecology does not only concern about farming practices but it is a holistic or systemic approach including cultural diversity and social justice as important aims of our food and farming systems. Thus, agro-ecology addresses the economic and social drivers of the chronic hunger underwent by about 800 million people around the world as it is a systemic approach to food and farming systems (SDSN, 2013). Agro-ecological farming techniques comprise cropping systems such as intercropping, cover cropping, crop rotation, conservation tillage, composting, managed livestock grazing, and combined animal and plant production. The latter practices increase biodiversity, natural soil fertility, water conservation and the biological control of insects (Cook et al., 2016; Nyeleni, 2007; Altieri et. al., 1998).

The Contribution of Agro-ecology Approach to the Security of Food, the Realization of the Right to Food, and the Abolition of Poverty

There are much evidence that agro-ecological approaches contribute significantly to the security of food and the recognition of the Right to Sufficient Food; mostly in four ways: by enhancing yields substantially (availability), by boosting urban agriculture (availability), by reducing poverty (accessibility) and by guaranteeing the sufficient character of food (adequacy) (FAO, 1996; Parmentier, 2014; De Schutter, 2010a).

Increasing the Availability of Food by Enhancing Yields Substantially

When adopting most agro-ecological methods, the increases in food production of 50-100% are fairly common to be obtained (Parmentier, 2014; Altieri et al., 2011a). For example, about 100,000 family farms have adopted agro-ecological farming techniques nowadays which show escalations in yields of 300 percent and 100 percent for black beans and corn in Brazil while showing increases in resilience to irregular weather patterns (McKay, 2012). There are many other examples in addition to the latter. An impressive body of scientific proof which demonstrates how significantly agro-ecological shifts can upturn yields and the productivity of land exists. The broadest and methodical study on agro-ecological systems that is to date is the study where Pretty at al. (2006) compared the impacts of two hundred eighty-sixth latest agro-ecological projects in fifty-seven poor countries which cover thirty-seven million of hectares (representing 3 percent of the total area that is cultivated in developing countries) and found that such interventions had increased the productivity of the land on 12.6 million farms, with an average upsurge in crop yield of 79 percent 24 while ameliorating the stock of critical environmental functions such as carbon sequestration, significant decline in pesticide use25, and water use efficiency gains. The average of food produced per household increased by 1.7 tons per year (i.e. up to 73 %) for 4.42 million of small farmers who were growing cereals and roots on the space of 3.6 million hectare, and the upsurge in food production was of 17 tons per year (i.e. up to 150 %) for 146,000 farmers on 542,000 hectares who were cultivating roots (such as potato, sweet potato, cassava) (Parmentier, 2014). Then, UNCTAD and UNEP (2008) repeated the analysis of the database of 286 projects in order to make a summary of the impacts of one hundred fourteen agro-ecological/organic projects in Africa. The results revealed that the average crop yields were straight higher than the overall average of 79 % and had become more than the double, with an increase of 116 percent in average for all projects of Africa and an increase of 128 percent for projects in Eastern Africa (Parmentier, 2014). Numerous other global assessments confirm the capacity of agro-ecological farming to increase yields as shown in table below:

Outcomes of Yields, food production and food security for the selected key global assessments on agro-ecological projects according to De Schutter (2010a) and Altieri et al. (2012b) in Parmentier (2014)

Selected Major Global Assessments	Main Reported Yields, Outcomes of Food Production and/or Food Security
Pretty J.N., Morrison J.I.L., Hine R.E., 2003. 'Decreasing food poverty by increasing the sustainability of agricultural in the developing countries', Agriculture, Ecosystems and	Strong increases in food production over some 29 million ha, with closely 9 million households profiting from the augmented diversity and security of food. Promoted sustainable

Environment, 95:217-234. Focus / scope: 208 agro-ecologically based projects and initiatives throughout the developing world.	Agriculture techniques have led to 50-100% upsurges in food production in rain-fed typical of minor farmers living in marginal environments; this has covered an area of nearly 3.58 million hectares, cultivated by approximately 4.42 million farmers.
Badgley C., Moghtader J., Quintero E., Zakem E., Chappell M.J., Avilés-Vasquez K., Salumon A., Perfecto I., 2007. 'Organic agriculture and the global food supply', Renewable Agriculture and Food Systems, Vol 22, Issue 02 (June), pp.86-108. Focus / scope: Compilation of research from 293 different comparisons to evaluate the total efficiency of organic from developed and developing countries26 versus conventional farming systems.	Agro-ecological organic agricultural systems in developing countries made 80 percent more than conventional farms.
IAASTD, 2009. Agriculture at a Crossroads. Sub-Saharan Africa (SSA) Report. Island Press, Washington DC. Focus / scope: Assessment of the significance, quality and efficiency of farming knowledge, science, and technology (AKST), with respect to meeting the development and sustainability goals of decreasing hunger and poverty, enhancing nutrition, health and rural livelihoods, and enabling social and environmental sustainability.	This report offers and refers to a rising body of evidence proving that the investment in agro-ecological approaches can be greatly effective in enhancing production and food security.
The Government Office for Science, 2011. Foresight. The Future of Food and Farming: Challenges and choices for global sustaina-bility. Final project report, London (research commissioned by the Foresight Global Food and Farming Futures Project of the UK Gover-nment). Focus / scope: analysis of forty projects and programmes in twenty countries of Africa where sustainable intensification, with agro-ecological approaches, with developed in the 1990s-2000s years. The project particularly comprised crop improvements, agroforestry and soil conservation, conservation agriculture and Integrated pest management.	The food production by agro-ecology through the use of new and ameliorated varieties was significant as crop yields increased on average by 2.13-fold. Most households considerably enhanced food production and household food security. In 95 percent of the projects aiming at growing yields, cereal yields increased by 50-100 percent. Overall farm food production augmented. Though some of the yield increases stated in the study depended on farmers having access to ameliorated seeds, fertilizers and other inputs, food productions enhanced primarily by diversification with a collection of new crops, livestock or fish that added to the existing staples already being cultivated.
Bachmann L., Cruzada E., Wright S., 2009. Food security and farmer empowerment: a study of the impacts of farmer-led sustainable agriculture in the Philippine. MASIPAG (Magsasaka at Siyentipiko parasa Pag-unlad ng Agrikultura) and MISEREOR (German Catholic Bishops' Organisation for Development Cooperation). Focus / scope: The study on sustainable agriculture in Asia, which analyzed the work of MASIPAG, a network of small scale farmers, organizations of farmers, scientists and NGOs, comparing results from 280 complete (agro-ecological) organic farmers, 280 in conversion to organic agriculture and, 280 conventional farmers considered as a reference group.	Food security was considerably higher for organic farmers. The study shown that the complete organic farmers had significantly higher on-farm diversity, rising on average 50% more crops than conventional farms.

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The significant increases in yields are intensely related to the rise of agricultural biodiversity resulting from many techniques including crops diversification, agroforestry, integrated nutrient management, restoration of previously ruined land, or incorporation of livestock into agricultural systems (De Schutter, 2010a, Altieri et al., 2012b; Parmentier, 2014). The other factors that explain the increase in yields are greater levels of the soil organic material (SOM) and higher water productivity (Altieri et al., 2012b; Parmentier. 2014; Bargout, 2012; De Schutter, 2010a) that plays a determinant role of crop productivity (Branca et al., 2011). The positive effects on yields hang on the whole package i.e. the context-specific mixture of practices that is accepted in a given context according to the review of the literature. The latter likewise demonstrates that profits in yield arise mainly over time. Depending on basic agro-ecological conditions, former land use arrangements, and present land use and management practices; short-term impacts certainly may sometimes be negative (Branca et al., 2011). This state occurs particularly when more industrial farms are being transitioned to agro-ecological ones since improving and constructing land productivity once more takes time, because time is obligatory to bring back the health of local ecosystems. Thus, according to Trócaire (2012), the key defy of shift is the transformation of degraded, simplified production systems to diverse, agro-ecological, resistant and small carbon systems; and to attain this without the loss of productivity in the process. The above table emphases only on indicated impacts of yields, food production and/or food security, and the global evaluations cited at the same moment a lot of other sustainability gains such as the resilience to climate change.

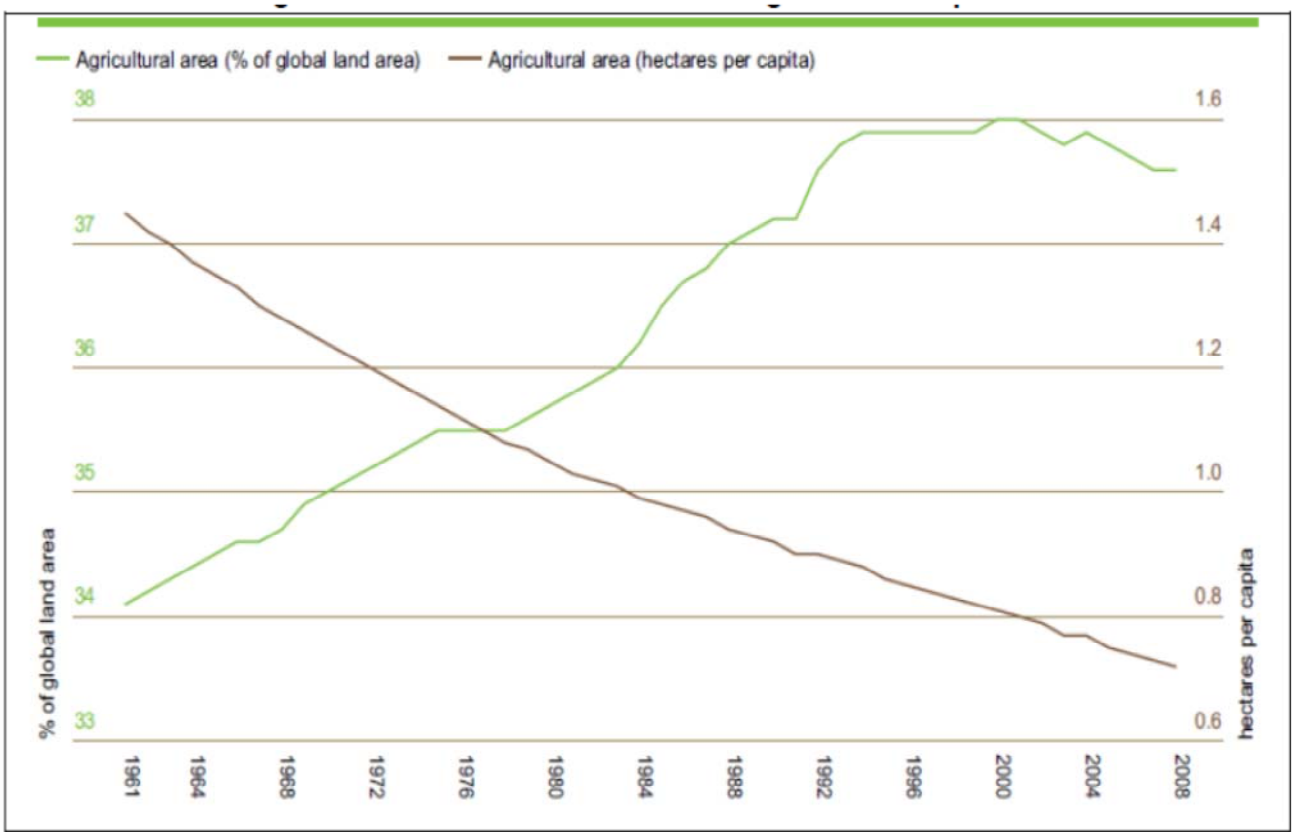

Figure. 5. Peaked Portion of Land Dedicated to Farming

(Source Reproduced from Bailev.2011. calculated from FAO.http://faostat.fao.org/site/377/default.aspx)

When compared especially to large scale industrial agriculture, the high land productivity of agro-ecological agriculture is a big strength given land scarcity. Land is more and more scarce. As seen in the above figure, the portion of land dedicated to farming has peaked and the quantity of arable land for each head has considerably decreased since 1960. Land is certainly quite limited even though; there is absence of clear estimation of how much land remains (Bailey, 2011). In its final report of 2011 tilted The Future of Food and Farming project, the Government Office for Science accounts that

there are strong environmental lands for restraining any substantial expansion of farming land in the future, and recommends to policy makers to work on the hypothesis that there is slight novel land for agriculture as one of the key priorities action for them (The Government Office for Science, 2011). While the spaces which are being targeted for the purpose of large-scale investments are commonly described as empty, marginal, futile or ruined lands, generally uninhabited, idle or unused, unfertile, and improbable to compete with the production of local food (Franco et al., 2013), it is not the situation in reality. Those lands play a critical role in the food security and employments or livelihoods of disregarded people such as pastoralists, local peoples and women (Bailey, 2011).

Raising Food Availability of by Enhancing Urban Agriculture

Twenty-five percent of the whole worldwide food output is grown in cities conferring to one approximation cited by the Canada's International Development Research Centre (IDRC). This amount might even underestimate considerably the up-to-date level of urban food production as history indicates that urban farming production increases with food prices since undertaken before the 2008 exacerbation of the food crisis (Parmentier, 2014; ETC Group, 2009). Urban agriculture or intra-urban agriculture also takes place within the city. In most cities; there are unused and under-utilized land spaces that are or can be utilized for urban farming and which have various forms such as home gardens, formal or informal community gardens, institutional gardens (i.e. managed by schools, hospitals, prisons, factories), nurseries, cultivation in basements and outbuildings (e.g. mushrooms, earthworms) and rooftop garden (FAO, 2007; Parmentier, 2014). Agro-ecological farming is principally suitable for rising urban agriculture for the reason that it permits mainly enormous land productivity rises on very small plots of lands to meet local food requirements while contributing to improving the wellbeing of urban communities via many social and environmental functions. By scaling-up of agro-ecological practices, Cuba has been a leader in urban farming. In Cuba; it is estimated that 383,000 urban farms, covering 50,000 ha of urban land, produce more than 1.5 million tons of vegetables by utilizing agro-ecological methods. This is sufficient to supply 40 to 60 percent or more of all the garden-fresh vegetables in towns such as Havana, Villa Clara and others with a form of farming that lessens food miles, energy and input use, and efficiently closes the cycles of local production and consumption (Altieri and Toledo, 2011; Parmentier, 2014).

Raising Food Accessibility by Decreasing Poverty

Agro-ecological farming also considerably contributes to attacking poverty primarily by raising the on-farm net incomes while generally keeping or at times even growing employment in agriculture and beyond. Although there is a shortage of broad and combined data that focuses on the economic viability or effectiveness of agro-ecological farming, evidence demonstrating positive effects of the adoption of agro-ecological approaches in terms of on-farm net incomes in many circumstances is supported by many examples. The initiatives of capacity building for promoting agro-ecological approaches conducted by PELUM (Participatory Ecological Land Use Movement) have especially revealed that the adoption of animal integration has led to the net incomes rises as most of the farmers did no longer had to buy artificial fertilizer for their farm and had profited from milk and meat gotten from animals (Altieri et al., 2012b). For instance in Brazil, the Food Agriculture Organization (FAO) established that the adoption of several improved cropland management practices has led to important net incomes upsurges. Similarly in Parana; terracing, reduced tillage, vegetative contours, integrated nutrient management augmented the net incomes by 104 percent while in Santa Caterina; conservation farming and agroforestry permitted an average net income rise of 161 percent. The one key factor that has contributed to these economic profits is the considerable crop productivity increases resulting from the adoption of the techniques (i.e. a percentage near to 82 and 205 in Parana and Santa Caterina; respectively) (Branca et al., 201; Parmentier, 2014). One more example is given by the study of 2009 on the work of MASIPAG in the Philippines which established that the group of complete organic farmers had on average greater net incomes which had increased since 2000 in comparison to stagnant or decreasing incomes for the reference group of inorganic or conventional farmers. The organic farmers profited from the net incomes one and a demi- times greater than those of inorganic or conventional farmers. The organic farmers had a positive cash balance per year for households while inorganic farmers experienced a shortage or deficit in the cash balance for household on average. This is the reason why the organic farmers were less indebted than the conventional ones (Altieri et al., 2012b). The illustration from these examples show that the upsurge in yields and independence or reduced dependency on outside inputs are two important elements elucidating why agro-ecological methods customarily lead to on-farm net income increase. As agro-ecology decreases the reliance of farmers on exterior inputs (De Schutter, 2010; Parmentier, 2014) and the dependency on state aids or subsidies that are dependence induces, it makes the

vulnerable farmers less reliant on local moneylenders and retail dealers (De Schutter, 2010a). The economic benefits from agro-ecological farming systems can also depend on the reduced economic susceptibility of farmers to crop failures or to the volatility of food prices. Surely, the diversification of the different activities that agro-ecology mostly consist of permits farmers to pay compensation for probable crop failures due to the adversarial climatic conditions and other natural ones via better outcomes for other crops or compensate the market price diminutions for one particular product by further remunerative charges or prices for others (Levard and Apollin, 2013). In this case, agro-ecological farming systems offer in-built systems of insurance for smallholders which make them further resistant or resilient to the diverse shocks such as economic, climatic and other natural ones (Bargout, 2012). The biodiversity offers a buffer against environmental variations since different species react in a different way to oscillations. This case leads to a further foreseeable aggregate community or ecological unit properties. This variety or diversity permits the maintenance of the functional capacity of a system in contrast to possible human management failure which can result from an incomplete understanding of the impacts of the environmental modification (Lin, 2011). Additionally, extra economic profits can at times result from a better upgrade of the production through short paths (Levard and Apollin, 2013). At farm level, the progression of the net incomes hangs both on differences in the gross income of farming activity and on the progression of production costs generally. When farms adopt or are involved more in agro-ecological systems, the gross income largely rises further than production charges. Acknowledgements to substantial yields upturns as suggested by Levard and Apollin (2013). They propose that this is typically the situation for old-fashioned or traditional peasant farms. However, they propose that for farms that are partially or totally industrialized, the situation can be not the same at least in the short period since such farms at times face initial decays in yields. They show that the agricultural added value have a tendency to rise, every so often considerably, even when yields are decreasing that in all cases. Definitely, when such regressions occur, they are every so often economically waged by huge diminution in production costs due to the replacement of costly off-farm inputs by interior solutions to the agricultural system (Levard and Apollin, 2013).

Rising the Sufficiency of Food by Supplying a High-quality Nutritional, Healthy and Culturally Adopted Food

In contrary to industrial agriculture of the green revolution, nutritionists more and more highlight the need for further varied agro-ecosystems for guaranteeing a further diverse nutrient output of the agricultural systems and so more diversified foods. Agro-ecological farming usually meets this concern; raising nutritional variety which is of specific importance to children and women as it enormously promotes varied or diverse cropping systems; comprising with respect to species on the farm in both rural and urban areas (De Schutter, 2010a). Agro-ecological farming conduct to valorizing and making the best usage of traditionally cultivated crops which agriculture style of the Green Revolution has underutilized as it is embedded in local cultures. The nutritional value of these crops is great, with abundant quantities of micronutrients, antioxidants and indispensable amino acids for the consumer (Jacobsen et al., 2013). Some studies showed that crops grown by agro-ecological organic farming methods improves diets because they contain considerably further vitamin C, iron, magnesium and phosphates and less nitrates than conventional ones (Curtis, 2012). The positive effects of agro-ecological agriculture on the health of user or consumer result also from the decrease to a complete minimum of synthetic inputs it involves. In addition, the on-farm recycling of certain rubbishes of a specific activity contribute to decreasing the discharge of constituents such as pesticides, antibiotics and nitrates residues into the environment which are harmful to the health of human (Levard and Apollin, 2013; Parmentier, 2014).

Contribution of Agro-ecology to the Security of Water and the Realization of the Right to Water and Hygiene

The access to sufficient water is essential to an acceptable standard of living and is acknowledged as a fundamental human right underneath the UDHR (Universal Declaration of Human Rights) and the ICESCR (International Covenant on Economic, Social and Cultural Rights). According to Chopra (2010), the right to harmless and clean drinking water and hygiene or sanitation as a human right is indispensable for the complete enjoyment of total human rights. As defined by Grey and Sadoff (2007), water security is the availability of an adequate quantity and quality of water for health or wellbeing, livings, ecosystems and production combined with an tolerable level of water-related dangers to people, environments and economies. However, 780 million of people worldwide are

lacking the access to uncontaminated or unpolluted water, and that 3, 4 million of people die every year because of water, sanitation, and hygiene-related reasons (Water.org, 2012). Water insecurity and scarcity is mainly caused by water pollution from industrial agriculture in several portions of the world (Varghese, 2011). Global warming and population growth will exacerbate the problem in the already water-stressed food system in affected regions (Bailey, 2011). It is therefore, crucial to improve water use efficiency or productivity. Agro-ecological farming can provide such solution through constructing soils in good health and ameliorating water preservation and water gathering in rain-fed regions via various approaches. Adopting and applying agro-ecological farming will therefore be greatly valued for lessening the stress on water resources, raising the resilience to water shortage, decreasing the incidence of fights or conflicts among competing water uses and, eventually, contributing to the security of water and the realization of the right to water and hygiene. This will also increase the security of food and the realization of the right to sufficient or acceptable Food, acknowledgements to the important yields upturns which result from greater productivity of water and its likely positive economic impacts. Chopra (2010) stated that the persons who lack secure access to water for their personal uses are very probable to be experiencing severe or long-lasting (chronic) hunger, and vice versa. The food right also depends on access to water because to produce food obliges the access to sufficient or acceptable water for farming (Chopra, 2010). Moreover, the access of women to harmless water for domestic use is of greatest importance to ensure food security at the household-level (Varghese, 2011).

Contribution of Agro-ecology on Preserving Biodiversity and Natural resources

Agro-ecological farming is totally devoted to the improvement of sustainability with regard to environmental protection. Agro-ecology allows to avoid overexploitation and contamination of land and water resources and to restore the ruined lands or enhance the fertility of soils by rising SOM (Utviklingsfondet, 2011; Altieri et al., 2012b; Curtis, 2012; Levard and Apollin, 2013). Its principles encourage significant variation that happens in several forms and over different scales (Lin, 2011). They further optimize the chronological important contribution of old-style peasant agriculture systems to the conservation and protection of biodiversity. These principles also invoke addressing local needs thus making short the paths of food production and consumption and escaping or avoiding the great energy needs of the long-distance food (Altieri and Toledo, 2011).

Contribution of Agro-ecology in Rising the Resilience to Climate Change and Addressing the Mitigation Defy

Promoting agro-ecological farming enhances the resilience of farmers to adversarial effects and dangers that they go through as a result of global warming, and helps mitigating GHG emissions resulting from agriculture via a dual pathway: boosting the existing resilience of peasant cultivations to climate change and their alleviation potential and shifting industrialized farming to further agro-ecological systems principally with the resolution of extenuating present inputs of farming to climate change. This will also contribute to the mitigation of emissions from GHGs made more generally by food systems.

Increasing Resilience to Climate Change

Results from many studies show that agro-ecological farming is climate resistant or resilient (Li Ching and Stabinsky, 2011; Altieri and Nicholls, 2012). It permits farmers to deal with severe environmental pressures whose incidence are projected to come to be more regular because of climate change such as austere droughts and floods, temperatures oscillations, heavy storms, little precipitation and decreased soil and water availability or the incursion of new diseases, weeds and pests (De Schutter, 2010a; Swiderska et al., 2011; Altieri and Nicholls, 2012; Altieri et al., 2012b). For instance, many family farmers who have shifted to use of green manures and cover crops in Brazil, have got an experience of lesser oscillations in soil moisture and temperature and a decline in soil erosion levels. In severe drought of 2008-2009, farmers who shifted to no-till agro-ecological practices experienced less loss in yield (only 20%) which confirms the bigger or higher resilience of these systems while those practicing conventional agriculture experienced much yield loss (50 %) (Altieri and Nicholls,

2012). Another study conducted in hillsides of Central American after the 1998 Hurricane Mitch established that farmers using agro-ecological methods underwent fewer injury than their conventional colleagues (Altieri et al., 2011a). A study also showed that agro-ecological experimental parcels on sustainable farms starting from southern Nicaragua to the eastern Guatemala had experienced an average 40 percent further topsoil, 69 percent fewer gully erosion, greater field moisture and less economic declines or losses than controlled parcels on conventional gardens or farms (Holt-Giménez, 2002). Results from studies also show that agro-ecological approaches improve recovery after climatic disasters. A survey study which was conducted forty days after the 2008 Hurricane Ike hit Cuba, in the Holguin and Las Tunas Provinces, for example, found that not only farms which are agro-ecologically managed showed declines or losses of 50 percent in comparison to 90 or 100 percent in the adjacent monocultures, but that they also exhibited a quicker retrieval (80-90 percent) than farms which are managed in monoculture (Rosset et al., 2011). Several others illustrations or examples exist. The resilience of agro-ecological agriculture to the change in climate hangs on 4 key interconnected features or levers: augmenting the level of biodiversity (Altieri, 2008; De Schutter, 2010a; Tirado and Cotter, 2010; Altieri et al., 2011a; Li Ching, 2011; Li Ching and Stabinsky, 2011; Sahai, 2011; Altieri and Nicholls, 2012; Altieri et al., 2012b; Bargout, 2012; Jacobsen et al., 2013); constructing soils which are healthier (Li Ching and Stabinsky, 2011; Altieri and Nicholls, 2012; Bargout, 2012); enhancing water management and water gathering in rain-fed areas (De Schutter and Vanloqueren, 2011; Li Ching and Stabinsky, 2011; Sahai, 2011; Bargout, 2012); and boosting yields upturns (Li Ching and Stabinsky, 2011).

Addressing the Mitigation Challenge

The mitigation of agricultural GHG emissions is important to control, stop or reduce global warming from industrial agriculture (GRAIN, 2009a; Li Ching and Stabinsky, 2011; Sivakumaran, 2012). To achieve this objective, it is important to increase carbon sequestration because 89 percent of the full technical extenuation potential of agriculture is associated to carbon sequestration, approximately 9 percent being related to extenuation of methane and only around 2 percent related to mitigation of nitrous oxide emissions coming from soil (IPCC, 2007). Thus, adopting agro-ecological farming systems can considerably contribute to mitigation since this farming system is very efficient in sequestering carbon. The relevant approaches are leaving waste or residues and decreasing tillage to hearten the accumulation of soil carbon, agroforestry, rotations of crop, cover crops, green manures and use of organic improvements such as compost (Li Ching, 2011). Promoting and adopting agro-ecological approaches will also considerably contribute to decreasing up-to-date overall emissions of GHG of the industrial food system as a whole, away from its agricultural element. The diminution and sequestration of 1/2 (one-half) to 3/4 (three-fourths) of present worldwide GHG emissions can be achieved by adopting four complementary measures: utilizing agro-ecological methods to restore the organic matter in soils which is lost from industrialized agriculture; ending land clearing and deforestation for cultivated areas; allocating food principally via local markets as an alternative to transnational food chains; regionalizing livestock farming and mixing it with crop production. For example, agro-ecology gives privileges to local markets that abbreviate the paths of food production and consumption, henceforward evading the great energy requirements of the 'long-distance food' (Altieri and Toledo, 2011). Also, adoption of agro-ecology can also conduct to ending land clearing and deforestation for cultivated area because of the important yields / land productivity rises that its adoption involves. Ending land clearing and deforestation for farming itself can allow an overall GHG emissions diminution by 15 - 18 percent (GRAIN, 2009b). Conferring to the history, 75 percent of deforestation globally has been linked with agricultural expansion, industrial animal feed and agro-fuels (CTA, 2012).

Contribution of Agro-ecology in raising the Control of Peasants over Farming and Food Systems

Agro-ecology as a movement also aims at enhancing the sovereignty and peasants' control over their production systems, therefore contributing to Food Sovereignty which is considered as the right of

peoples to food which is healthy and culturally suitable and produced via environmentally or ecologically sound and as the control over their production systems by decreasing to a total minimum their reliance on off-farm inputs, state aids or subsidies to agrochemicals, local retail dealers and pawnbrokers. The increased control of peasants is also due to the bottom-up and farmer-led practices privileged for scheming and handling agro-ecological shift procedures as shown by the CaC methodology. These methods permit farmers or peasants to take the charge and control over transition procedures; permitting them to share, debate and decide what they need to do on their own (Sen, 2010). However, agro-ecological shifts can furthermore reinforce the control of peasants over food systems more broadly via the development of AAFNs and the growing influence on public policy. AAFNs are often supportive of and embedded in agro-ecological agriculture, and seek out to diminish the dependence on industrial agri-food systems. The right practice of the alternate model that they symbolize rises the control at various levels of farmers, consumers and other civil society actors. Also agro-ecology as a movement closes relations with the unity or solidarity economy which has been established principally in the 1990s in the situation of the economic disaster or crisis in Latin America (Nobrega, 2013), whereas also rising in other portions of the world. For example Brazil, which has arose as a leader of this novel movement (Nobrega, 2013), the organizations of the unity or solidarity economy have been principally supportive of agro-ecological farmers; ameliorating the conditions in which they develop in the market (Fernandez and Gotuzzo, 2012). Finally, agro-ecology as a movement evolves a rising capacity to increase main public policy modifications that are wanted for promoting agro-ecological approaches at an advanced stage, even though defies to be encountered in this respect are huge and reaching them oblige long period fights. Public policy changes are both needed to provide specific support to agro-ecological farming and food systems and to address the obstacles from a series of guidelines/policies and practices which have in history underprivileged agricultural peasants in several international, regional and national contexts. Addressing these problems on the long period is key to release the remarkable sustainability potential that peasant agricultures hold traditionally. This potential can intensely increase via an agro-ecological modernization which combines old or traditional science and knowing-how with the contemporary agro-ecological knowledge (CLAS, 2011; De Schutter, 2010b; FAO, 2012).

Contribution of Agro-ecology in Empowering Women

Agro-ecology can benefit women because they are the ones who frequently labor in the furthermost ruined farming spaces and who have lesser revenues to buy costly inputs with lesser access to credits, thus, they meet more problems in accessing exterior inputs and aids/subsidies (De Schutter, 2010a; Curtis, 2012). Agro-ecology empowers women through making them leaders of novelties or innovations for reaching sustainability (Tripathi at al., 2012). Agro-ecological approaches have a big potential to empower women once the former are well conceived and managed. This empowerment can happen by helping women to be well conscious and aware of the defies and problems they are facing and realizing what they are capable of. By doing so, agro-ecological approaches mitigate their isolation, lead them to progressively value themselves, therefore increasing their self-esteem while encouraging their self- perception as change-agents. Via the sharing of experiences, women challenge one another to follow novel pathways, breakdown obstructions, and are heartened to leave several of their worries behindhand. The systematization of the experiences/skills of women is a key tool for empowering women, as well as an effective approach for deconstructing/criticizing and denaturalizing the dominance of men above women (Lopes and Jomalinis, 2011). Agro-ecological perspective allows collective action by putting women in their own groups/clusters. Such clusters offer facilitating spaces where disregarded women can gain self-esteem, self-confidence/confidence and skills/abilities. They are very effective in enabling them to detect or identify their wants, comprehend their rights and start to state or express their demands. However, the involvement of women in mixed clusters can as well be empowering, even though the work is required to increase equity within the groups depending on the context, (Tripathi et al., 2012). Agro-ecology as a movement can also give to women the opportunity to empower themselves enthusiastically via playing a fundamental role as promoters for change. This just as any other defenseless and disregarded group can do. For instance in India, 1000s (thousands) of women have been advocating for the insert of millets into the

description of food grains in the National Food Security Bill and the regionalized public delivery system, into the structure of a movement established by means of the Deccan Development Society (DDS) and the Millet Web of India (Tripathi et al., 2012).

6. PROMOTION AND ADOPTION OF AGRO-ECOLOGICAL APPROACHES

Despite its greater potential for meeting sustainability challenges, agro-ecology has not yet been much far diffused over the world due to a number of challenges (De Schutter, 2010a; Rosset and Martinez-Torrez, 2013). To ensure the adoption of agro-ecology will require farmer-to-farmer networks, institutionalizing supportive policies, flouting with series of guidelines/policies which altogether very frequently have underprivileged agricultural peasants and agro-ecology such as incorporating trade and agricultural policies/ guidelines which include the structural amendments programs of the World Bank and International Monetary Fund, the Arrangement/treaty on Agriculture of the World Trade Organization , and with the present tendencies in farming reinvestments which have a tendency to consolidate industrialized farming via the reformist program of viable intensification (De Schutter and Vanloqueren, 2011). From experience, sufficient and suitable provision/support and investment which come from the state can lead to efficient promotion and adoption of agro-ecology.

7. CONCLUSION

Despite the high and enough food production in the world, the number of hungry people is great and increasing: over one in every nine people in the world is currently unable to consume enough food to conduct an active and healthy life. Industrial agriculture has considerably led to this augmentation of hunger levels in the world by increasing inequalities in the agricultural and food system, increasing poverty rate at household level and increasing degradation of the environment. This degradation of the environment is menacing the sustainability of food production. Moreover, this form of agriculture promotes monoculture which has limited diversification of crops in agriculture production and led to unhealthy food; increasing malnutrition rate. Agro-ecology contributes to solving world hunger by addressing inequalities in the agricultural and food system, reducing poverty and malnutrition rate, and by protecting, conserving and restoring the environment. Agro-ecology enables revitalizing rural economies and advancing food sovereignty, democratizing governance and power in the food economy and rising revenues/incomes for small and mid-scale producers (especially women) while raising the resilience to climate change/modification and addressing mitigation challenges. It, therefore, permits to feed the world sustainably.

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