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; rises the accessibility of food by decreasing poverty; and upsurges the appropriateness of food by providing a high-quality nutritional, healthy and culturally appropriated food. This framing system also contributes to water security and the recognition of the right to water and sanitation by decreasing pressure on water resources, increasing resilience to water scarcity and reducing the frequency of conflicts between competing water uses; and therefore, enhances food security and the apprehension of the right to adequate food. Agro-ecology contributes on conserving biodiversity and natural resources, in increasing resilience to climate change and addressing the mitigation challenge, in growing peasants' control over agricultural and food systems, and in empowering Women too.

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

1. INTRODUCTION

Today's dominant industrial food and agricultural system is rapidly depleting and degrading the world's soil, water and biodiversity; intensifying climate disruption; consolidating wealth and power over food-related resources; and accelerating world poverty and hunger (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 undernutrition. Yet, eliminating hunger worldwide is one of humanity's greatest challenges in the 21st century (Lomborg, 2004). However, there are completely divergent visions for how to achieve this goal. A lot of people associate feeding the world with the need to produce more food, but this analysis leaves fundamental facts about world hunger out of the picture. In fact, the instruction to produce more food to feed the world is often raised to justify food and farming policies and practices that exacerbate the conditions of hunger and undermine our ability to feed future generations (Office of Technology Assessment, 1992). Feeding the world sustainably obliges that we protect the ecological resources that are essential for producing food now and in the future. Evidence show that agro-ecological farming, including diversified organic agriculture, is the most effective agricultural response to the environmental challenges that threaten our future food security, such as climate change, soil erosion, water scarcity and loss of biodiversity (Pretty et al., 2000; Wood et al., 2000; McNeely and Scherr, 2001). Additionally, research regularly proves that world hunger is not mainly a problem of overall supply of food, but rather of poverty, lack of democracy and unequal access to land, water and other resources and infrastructure , especially for women. Rather than simply producing more food under unequal conditions, the solution to hunger hinges on creating more democratic and fair political and economic systems that expand access to resources. 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 approach to food and farming (SDSN, 2013). It is a central pillar of food sovereignty while increasing the democratic control of our food production and challenging corporate power in our food system in order to combat

poverty, inequality 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. 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 physical, social and economic access to sufficient, safe and nutritious food, at all time, which meets their nutritional needs and food preferences for an active and healthy life. 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 sufficient quantities of food in appropriate quality, supplied via domestic production or imports, including food aid.

Food access

It is the access by individuals to adequate resources for acquiring appropriate foods for a nutritious food taking into account all commodity packages over which a person can establish command on resources, given the legal, political, economic and social arrangements of the community in which s/he lives, including traditional rights such as access to common resources (World Food Summit, 1996).

Utilization

It implies the utilization of food via adequate regime, clean water, sanitation and health care to reach a nutritional well-being where all physiological needs are met.

Stability

This means also that a population, household or individual have access to adequate food at all times. This stability must remain even when there are sudden shocks such as economic or climatic crises, or repeated events such as agricultural seasons. This stability is needed in both availability and access to food.

Relation between Food Insecurity, Hunger/ malnutrition and Poverty

These three or two concepts are related to food insecurity. Hunger is understood as an uncomfortable or painful sensation caused by insufficient food energy consumption. 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 hungry people are food insecure, but not all food insecure people are hungry because there are other causes of food insecurity such as those due to poor intake 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 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 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 deficiencies, excesses or imbalances in the consumption of macro- and/or micronutrients, it is an outcome of food insecurity and may relate to non-food factors such as: inadequate care practices for children, insufficient health services; and an unhealthy environment. Thus, poverty is among the main causes of hunger. It encompasses different dimensions of deprivation that relate to human capabilities including consumption and food security, health, education, rights, voice, security, dignity and decent work. The lack of adequate and proper nutrition itself is one of the underlying causes of poverty. To resolve the problem of food insecurity, poverty and hunger; a combination of income growth supported by direct nutrition interventions and investment in health, water 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 slowed considerably recently 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.

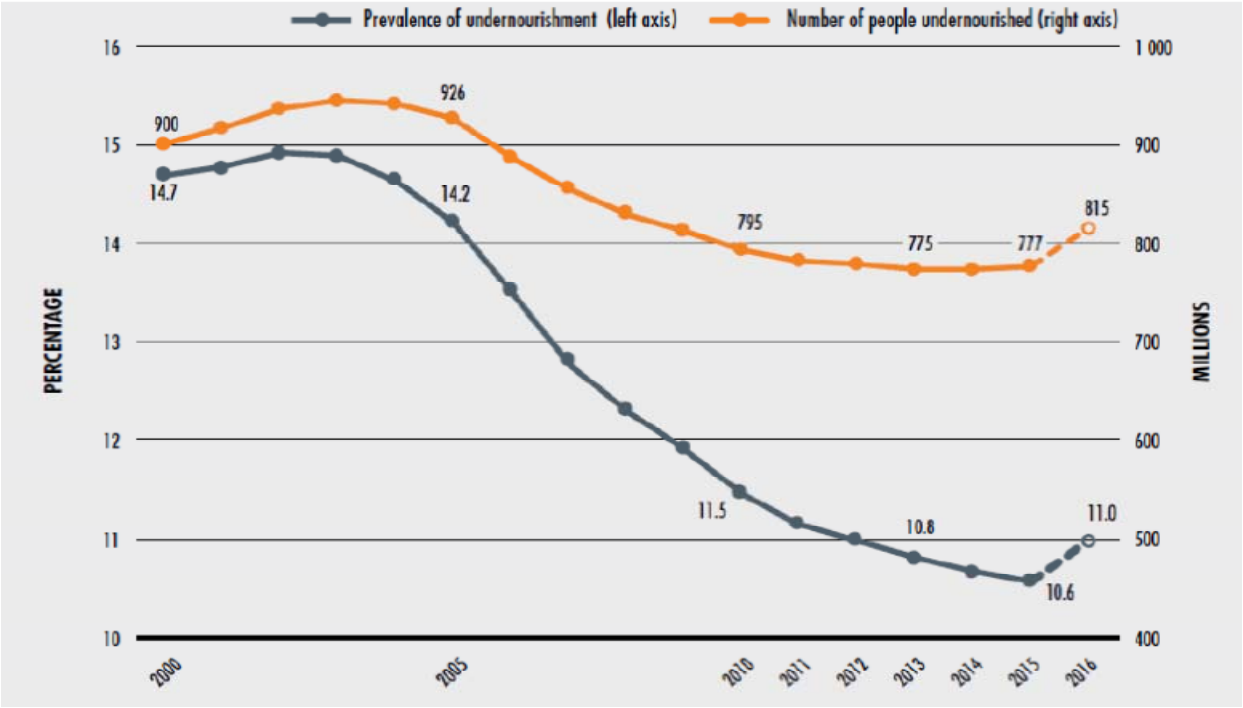

Figure. 1. General Prevalence of Undernourished in the Word
(Source FAO, 2016)

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 in 2014 from 775 million people to 777 million in 2015 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 increased in most regions except 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 near levels reached in 2011 in Asia region. But, levels remain low in Latin America, especially in South America, where the PoU climbed from 5 percent in 2015 to 5.6 percent in 2016. The highest number of undernourished 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 in Latin America and the Caribbean do not have access to sufficient food energy. The recent increase in the prevalence of undernourishment can be attributed to a variety of factors: 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. Also, 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.

3. WHY INDUSTRIAL AGRICULTURE IS NO LONGER VIABLE?

The spread of industrial agriculture has considerably contributed to food production increases over the last years (Koohafkan, 2011). The green revolution of agriculture doubled cereal production in many parts of the world via the use of improved seeds varieties in 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 lowering cereal prices, benefiting poor consumers i.e. higher calorie availability, less malnourished children (Hazel, 2003; IFAD, 2010). However, there is also evidence showing that agricultural industrialization has contributed significantly to worsen poverty, hunger and malnutrition levels by increasing inequalities among farmers and economic debt or rural exodus (Mazoyer, 2008; Utviklingsfondet, 2011; McKay, 2012). The Green Revolution (i.e. agricultural intensification) failed to ensure Safe and abundant food production for all people and assumed that abundant water and cheap energy to fuel modern agriculture will always be available; that climate will be stable and will not change. Yet, agrochemicals, fuel based mechanization and irrigation operations are derived from declining and ever more expensive fossil fuels; climate extremes are becoming more frequent and violent , and threaten genetically homogeneous modern monocultures is now covering 80% of the 1500 million Hectares of global arable land. Also, industrial agriculture contributes 25 to 30% of Green House Gas emissions, altering weather patterns hence compromising the world's capacity to produce food in future. Thus, industrial agriculture has been responsible for major social and environmental costs in the last five decades that there is a growing need to shift to a much more sustainable agricultural paradigm (De Schutter and Vanloqueren, 2011; Koohafkan, 2011; McKay, 2012). Also, in the context of climate change and energy scarcity, industrial agricultural model cannot allow the world to feed itself today and in the future while there is a resource constrained world. (IAASTD, 2009; Altieri and Toledo, 2011; De Schutter and Vanloqueren, 2011; Utviklingsfondet, 2011).

Ecological footprint of Industrial agriculture

The rate of increase in cereal yields is declining in some of the major grain production areas of the world as real crop yields approach an upper limit for maximal yield potential. Also; serious questions about the social, economic and environmental sustainability of modern agricultural strategies are rising when the petroleum dependence and the ecological footprint of industrial agriculture are accounted for. The intensification of agriculture by the use of high yielding crop varieties, fertilization, irrigation and pesticides impact deeply on natural resources with serious health and environmental consequences (Altieri, 2012).

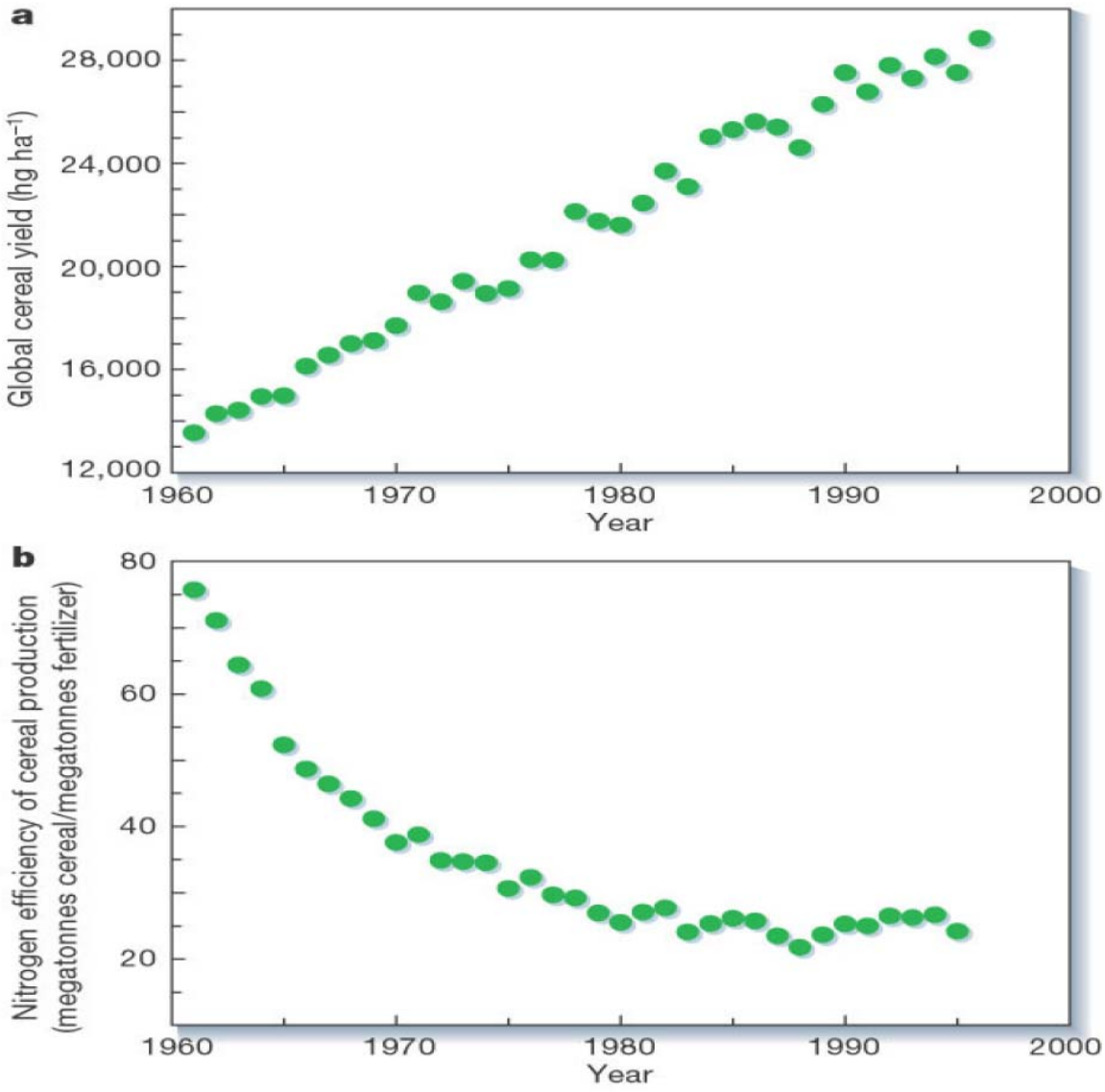

Figure. 3. Ecological Footprint of Industrial Agriculture
(Source Altieri, 2012)

The external costs of UK agriculture is estimated to be at least 1.5 to 2 billion pounds every year and to nearly 13 billion Pounds per year in the US amount, getting up from damage to water resources, soils, air, wildlife and biodiversity, and harm To human health. In Addition, annual costs of USD 3.7 billion rises from agency costs associated with programs to address these problems or 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 use of pesticides has increased intensely in the world in the past 50 years and has now reached 2, 6 million tons of pesticides per year with an annual value of more than US$ 25 billion in the global market (Lichtfouse, 2012). This increment in pesticides use has results into indirect environmental impacts and social costs reaching around $8 billion every year. Hence, 540 species of arthropods have developed resistance against more than 1000 different types of pesticides. Thus, those pests can no longer be controlled by those chemicals.

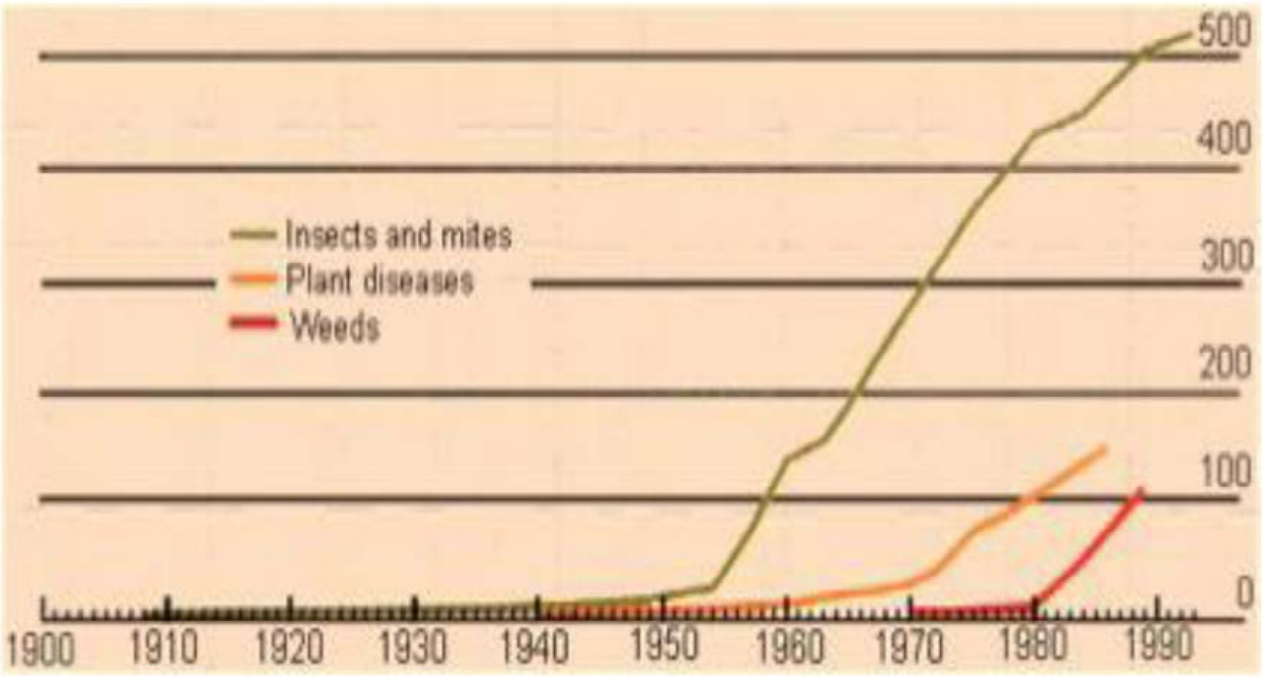

Figure. 4. Rapid Development of resistance to pesticides by insects, pathogens and weeds
(Source Altieri, 2012)

Agribusiness and World Hunger

Currently there are almost 1 billion hungry people in the world (World Bank, 2016; FAO, 2015). This hunger is caused by poverty (very little earning) and inequalities (lack of access to land, seeds, capital, unequal distribution, priorities etc.) but not 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 growing population of livestock 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 people's food needs (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 but hunger continues to grow) but food distribution i.e. to ensure if people have sufficient rights or power on land, income and have support networks to secure a healthy food (WFP, 2017; FAO, 2017). By undercutting prices and destroying the economic Viability of local agricultural systems, for example, farmers are unable to sell their produce in a way that allows them to cover costs. 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 Concentration of Global Food Production

The industrial agriculture undermines the possibility of addressing the root causes of hunger by accelerating land and resource concentration in the hands of a few. This concentration of global food production under 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 the production of cash crop exports in exchange for food imports and the expansion of biofuels. This situation is worsening by food insecure governments (e.g.

China, Saudi Arabia and South Korea) that depend on imports to feed their people which are snatching up vast areas of farmland (more than 80 million hectares already transacted) overseas for their own offshore food production. Also, the investment in foreign farmland is seen as an important new source of revenue from the production of biomass (Magdoff et al., 2000; Pimbert et al., 2000). 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.

4. 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 a science that seeks to understand the internal working of agricultural ecosystems and including a part of the human component (Carroll et al., 1990; Altieri, 1995, Gliessman, 2007). It implies farming methods that are based on the application of principles which are haggard from biology for agro-ecology practitioners (increasing the recycling of biomass, assuring favorable soil conditions, minimizing nutrient losses from the system, promoting the functional biodiversity of the system and promoting increased biological interactions and synergisms) (Altieri, 1995; 2002; 2007) . By applying the former principles, agro-ecology improves agricultural systems by imitating natural processes and then, enhancing beneficial biological interactions and synergies among the components of 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 comprise the majority of the rural poor and ameliorate its conditions by stabilizing the yields and enhancing food security ((Pretty, 2008; Altieri, 2012). Agro-ecological farming has significant advantages over industrial agriculture for people and for the earth (IAASTD, 2008; De Schutter, 2011). The most important are : production of sufficient and healthy food for local people (food sovereignty), rural livelihoods and cultures, resilience to climate and other shocks, lower greenhouse gas emissions, lower production costs or less indebtedness, better stewardship of productive resources and biodiversity and greater autonomy and less external dependence.

Production of Sufficient and Healthy Food for Local People

Many recent studies have shown that small farms are more productive than large farms (Rosset, 1999); and agro-ecological systems are as productive, and in many cases more productive, than chemical-dependent monocultures (Badgley et al., 2007; Pretty and Hine, 2001; Pretty et al., 2003; De Schutter, 2011). Integrated agro-ecological systems on small farms are the most productive systems per unit area (Rosset et al., 2011; Machín Sosa, et al., 2013).

Rural Livelihoods and Cultures

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

Resilience to Climate and Other Shocks

Agro-ecological farming systems are diversified and therefore, far more resistant and resilient when faced with climate and other shocks (Rosset et al., 2011; Altieri and Koohafkan, 2008).

Lower Greenhouse Gas Emissions

A more localized food system, based on agro-ecological small farms producing for local and national markets, would significantly reduce GHG emissions (Vandermeer et al., 2009; LVC, 2009).

Lower production costs, less indebtedness

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

Better Stewardship of Productive Resources and Biodiversity

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

Greater Autonomy and Less External Dependence

Agro-ecology can help peasants and family farmers to build relative autonomy from the credit, input and global output markets that operate on unfavorable 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 hunger is not primarily a problem of overall supply of food, but rather of poverty, lack of democracy and unequal access to land, water and other resources and infrastructure, especially 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, 2013b). 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). For instance, much of agricultural production worldwide is not devoted to feeding people. In the U.S., for example, 36 percent of all slush is used to feed livestock, another 40 percent for biofuels. This situation means that huge quantities of farmland that might produce a variety of nutritious foods are locked up in feed and fuel production. These trends are replicated universally: approximately one-third of grain produced worldwide becomes animal feed while 17 percent goes to ethanol and other biofuels. Dedicating land and food crops to biofuel production is mainly harmful because it increases food prices and turn away land and resources from food production (World Food Program, 2000). Lastly, about one-third of the food that is produced globally is lost to waste and spoilage or left in the field. To resolve world hunger we, therefore, need agro-ecological farming which enables policies and programs that democratize access to food, arable land, water, credit and fair markets, particularly for women. Agro-ecological solutions to hunger pivots on creating more democratic and fair political and economic systems that expand access to resources. Agro-ecology is a central pillar of food sovereignty, increasing the democratic control of our food production and challenging corporate power in our food system in order to combat poverty, inequality and hunger. This approach helps to address hunger and poverty sustainably because allows expanding public investments to the small food producers who make up more than 90 percent of all farmers worldwide and provide more than 80 percent of the food consumed in much of the developing world, mainly Southern Asia and sub-Saharan Africa. Raising small farmers' ability to feed themselves and their communities is fundamental to food security and poverty reduction, especially for more than 1 billion poor, rural people worldwide (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 feed for livestock and biofuels. Thus, agro-ecology is not only about farming practices, it is a holistic approach that includes cultural diversity and social justice as important aims of our food and faming systems. As a systemic approach to food and farming, agro-ecology addresses the social and economic drivers of chronic hunger suffered by approximately 800 million people around the world (SDSN, 2013). Agro-ecological farming methods include intercropping, cover cropping, crop rotation, conservation tillage, composting, managed livestock grazing and combined animal and plant production. These methods foster biodiversity, natural soil fertility, water conservation and biological control of insects (Cook et al., 2016; Nyeleni,

2012; Altieri et. al., 1998). Again it would be better to support your view by giving one or two examples on how this issue affects women household /farmer

Contribution of Agro-ecology to Food security and the Realization of the Right to Food, and Poverty Eradication

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

Increasing the Availability of Food by Enhancing Yields Substantially

When adopting most agro-ecological methods, increases in production of 50-100% are fairly common (Altieri et al., 2011a). For example, about 100,000 family farms have adopted agro-ecological farming practices today, showing increases in yields of 300 % and 100 % for black beans and corn (while increasing resilience to irregular weather patterns) in Brazil (McKay, 2012). This is one example among many others. An imposing body of scientific evidence which demonstrates how significantly agro-ecological transitions can increase yields (thus also land productivity) exists. The widest and systematic study on agro-ecological systems to date is where Pretty at al. (2006) compared the impacts of 286 recent agro-ecological projects in 57 poor countries covering 37 million ha (3 % of the total cultivated area in developing countries), finding that such interventions increased land productivity on 12.6 millions farms, with an average increase in crop yield of 79 %24, while improving the supply of critical environmental functions (water use efficiency gains, carbon sequestration and significant decline in pesticide use25). The average food production per household rose by 1.7 tons per year (up by 73 %) for 4.42 million small farmers growing cereals and roots on 3.6 million ha, and the increase in food production was 17 tons per year (up to 150 %) for 146,000 farmers on 542,000 ha cultivating roots (potato, sweet potato, cassava). Then, UNCTAD and UNEP reanalyzed the database of 286 projects to make a summary of the impacts of 114 agro-ecological organic projects in Africa. The results showed that the average crop yields were even higher than the global average of 79 % and had more than doubled, with an average increase of 116 % for all African projects and of 128 % for projects in East Africa (UNCTAD-UNEP, 2008). Several other global assessments confirm the capacity of agro-ecological farming to increase yields as shown in table below:

Yields, food production and food security outcomes of selected major global assessments on agro-ecological projects (De Schutter, 2010a; Altieri et al., 2012b).

Selected Major Global Assessments	Main Reported Yields, Food Production and/or Food Security Outcomes
Pretty J.N., Morrison J.I.L., Hine R.E., 2003. 'Reducing food poverty by increasing agri-cultural sustainability in the development countries', Agriculture, Ecosystems and Environment, 95:217-234. Focus / scope: 208 agro-ecologically based projects and initiatives throughout the developing world.	Clear increases in food production over some 29 million ha, with nearly nine million households benefitting from increased food Diversity and security. Promoted sustainable Agriculture practices led to 50-100% increases in food production in rain-fed typical of small farmers living in marginal environments; this covered an area of about 3.58 million ha, cultivated by some 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 assess the overall efficiency of organic (both from developed and developing countries26) versus conventional agricultural systems.	Agro-ecological organic farming systems in developing countries were producing 80% more than conventional farms.

IAASTD, 2009. Agriculture at a Crossroads. Sub-Saharan Africa (SSA) Report. Island Press, Washington DC. Focus / scope: Evaluation of the relevance, quality and effectiveness of agricultural knowledge, science, and technology (AKST), with respect to meeting development and sustainability goals of reducing hunger and poverty, improving nutrition, health and rural livelihoods, and facilitating social and environmental sustainability.	The report provides and refers to a growing body of evidence demonstrating that investing in agro-ecological approaches can be highly effective in boosting 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 40 projects and programmes in 20 African countries where sustainable intensification, including agro-ecological approaches, was developed in the 1990s-2000s. The project notably included crop improvements, agroforestry and soil conservation, conservation agriculture and Integrated pest management.	Food output by agro-ecology via the use of new and improved varieties was significant as crop yields rose on average by 2.13-fold. Most households substantially improved food produ-ction and household food security. In 95% of the projects aimed at increasing yields, cereal yields rose by 50-100%. Total farm food production increased. Although some of the yield gains reported in the study depended on farmers having access to improved seeds, fertilizers and other inputs, food outputs improved mainly by diversification with a range 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 Catho-lic Bishops' Organisation for Development Cooperation). Focus / scope: The study, pro-bably the largest one undertaken to date on sustainable agriculture in Asia, analyzed the work of MASIPAG, a network of small scale farmers, farmers' organizations, scientists and NGOs, comparing findings from 280 full (agro-ecological) organic farmers, 280 in con-version to organic agriculture and, as a reference group, 280 conventional farmers.	Food security was significantly higher for Organic farmers. The study revealed that the full organic farmers had considerably higher on-farm diversity, growing on average 50% more crops than conventional farms.

The significant increases in yields are intensely linked to the increase of agricultural biodiversity resulting from many techniques including crops diversification, agroforestry, integrated nutrient management, rehabilitation of formerly degraded land, or integration of livestock into farming systems (De Schutter, 2010a, Altieri et al., 2012b). The other factors that explain the increase in yields are higher levels of soil organic matter (SOM) and higher water productivity (Altieri et al., 2012b; Bargout, 2012; De Schutter, 2010a) that plays a determinant role of crop productivity (Branca et al., 2011). The positive impacts on yields depend on the entire package i.e. context-specific combination of practices that is adopted in a given context according to the review of the literature. The latter also shows that benefits in yield emerge particularly over time. Depending on underlying agro-ecological conditions, previous land use patterns, and current land use and management practices, short-term impacts certainly may sometimes be negative (Branca et al., 2011). This situation happens especially when transitioning more industrial farms towards agro-ecological ones because recovering and building land productivity again takes time, since time is required to restore the health of local ecosystems. Thus, according to Trócaire (2012), the key transition challenge is the conversion of degraded, simplified production systems to diverse, agro-ecological, resilient, low carbon systems, and to achieve this without losing productivity in the process. The above table only focuses on yields, food

production and/or food security reported impacts, and global assessments mentioned at the same time many other sustainability advantages such as the resilience to climate change.

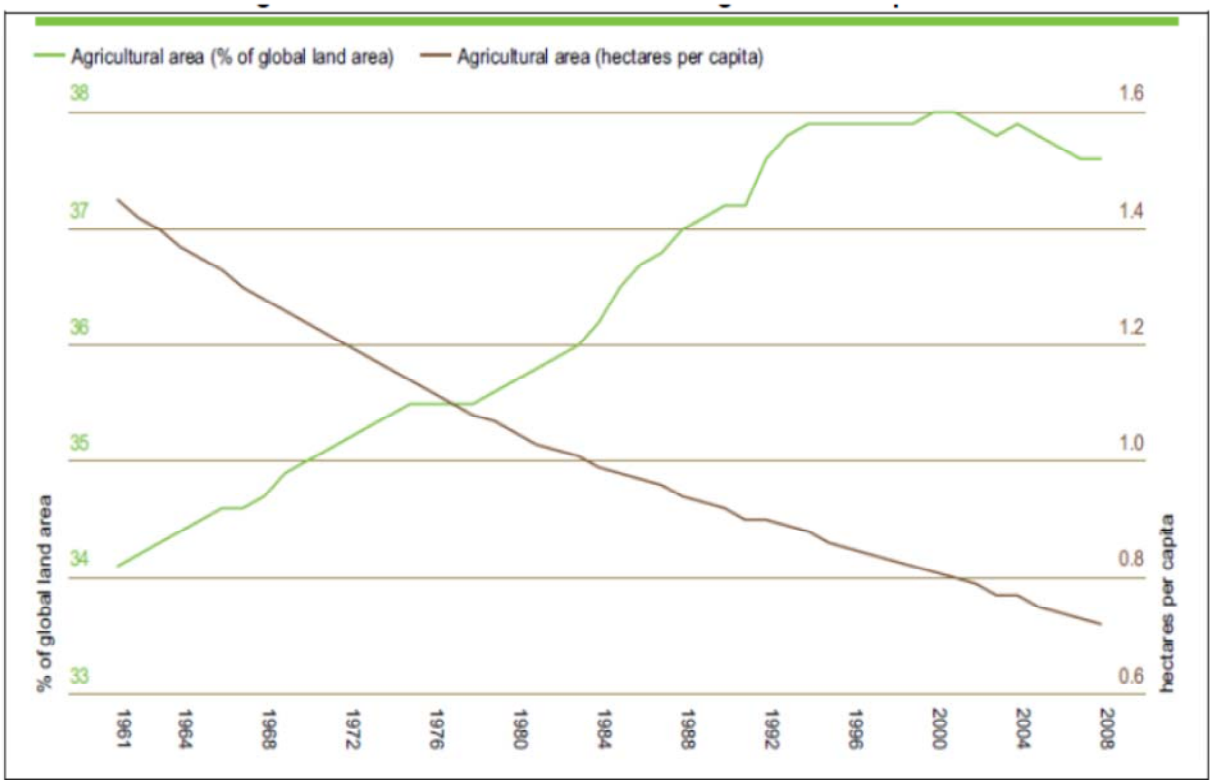

Figure. 5. Peaked Share of Land devoted to Agriculture

(Source Reproducedfrom 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 farming is a great asset given land scarcity. Land is more and more scarce. As seen in the above figure, the share of land devoted to agriculture has peaked and the amount of arable land per head has considerably decreased since 1960. Land is certainly quite limited even though; there is no clear estimate of how much land remains (Bailey, 2011). In its final report of 2011- The Future of Food and Farming project, the Government Office for Science records that there are strong environmental grounds for limiting any significant expansion of agricultural land in the future, and recommends to policy makers to work on the assumption that there is little new land for agriculture as one of the key priorities action for them (The Gover-nment Office for Science, 2011). Whereas the areas which are being targeted for large-scale investments are usually described as empty, marginal, idle or degraded lands, largely unpopulated, unused, unproductive, and unlikely to compete with local food production (Franco et al., 2013), it is not the case in reality. Those lands play a critical role in the food security and livelihoods of marginalized people i.e. pastoralists, indigenous peoples and women (Bailey, 2011).

Increasing the Availability of Food by Boosting Urban Agriculture

25% of the entire global food output is grown in cities according to one estimate cited by Canada's International Development Research Centre (IDRC). This figure might even underestimate significantly the current level of urban food production, as history shows that urban agriculture production rises with food prices because undertaken before the 2008 aggravation of the food crisis (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 areas that are or can be used for urban agriculture, which have diverse forms such as community gardens (formal or informal), home gardens, institutional gardens (managed by schools, hospitals, prisons, factories), nurseries, roof top

gardening, cultivation in cellars and barns (e.g. mushrooms, earthworms) (FAO, 2007). Agro-ecological farming is particularly appropriate for developing urban agriculture because it allows mainly huge land productivity increases on very small plots on lands for meeting local food needs while contributing to improving the welfare of urban communities through various social and environmental functions. By scaling-up of agro-ecological approaches, Cuba has been a leader in urban agriculture. In this country; it is estimated that 383,000 urban farms, which cover 50,000 ha of urban landscape, produce over 1.5 million tons of vegetables using agro-ecological methods. With a form of agriculture that reduces food miles, energy and input use, and effectively closes local production and consumption cycles; this is enough to supply 40-60% or more of all the fresh vegetables in cities such as Havana, Villa Clara and others (Altieri and Toledo, 2011).

Increasing the Accessibility of Food by Reducing Poverty

Agro-ecological farming also considerably contributes to attacking poverty, primarily by increasing on-farm net incomes while generally maintaining or sometimes even increasing employment in agriculture and beyond. Even though there is a lack of broad and combined data focusing on the economic profitability of agro-ecological farming, evidence proving positive impacts of the adoption of agro-ecological methods in terms of on-farm net incomes in most cases is supported by many examples. Capacity building initiatives for scaling-up agro-ecological approaches conducted by PELUM (Participatory Ecological Land Use Movement) have especially shown that the adoption of animal integration led to net incomes increases as most of the farmers no longer had to buy artificial fertilizer for their garden, and benefitted from milk and meat from animals (Altieri et al., 2012b). For example, in Brazil, FAO found that the adoption of various improved cropland management practices led to significant net incomes increases. Also, in Parana, vegetative contours, reduced tillage, terracing, integrated nutrient management increased net incomes by 104% while in Santa Caterina conservation agriculture and agroforestry allowed an average net income increase of 161%. One important factor that has contributed to these economic benefits is the substantial crop productivity gains following the adoption of the techniques (a percentage close to 82%, and 205% respectively in Parana and Santa Caterina) (Branca et al., 2011). Another example is provided by the 2009 study on the work of MASIPAG in the Philippines which found that the group of full organic farmers had on average higher net incomes, having increased since 2000, in contrast to stagnant or decreasing incomes for the reference group of conventional farmers. Organic farmers benefited from net incomes one and a half times higher than those of conventional farmers. They had a positive annual cash balance for households, while conventional farmers experienced a deficit in the household cash balance on average. That is why the organic farmers were less indebted than their conventional colleagues (Altieri et al., 2012b). The illustration from these examples show that the increase in yields and independence or reduced dependence on external inputs are two important factors explaining why agro-ecological approaches usually lead to on-farm net income increase. As agro-ecology reduces farmers' reliance on external inputs and the dependence on state subsidies that are reliance induces, it makes vulnerable peasants less dependent on local retailers and moneylenders (De Schutter, 2010a). The economic benefits from agro-ecological farming systems can also depend on reduced economic vulnerability of farmers to crop failures or food prices volatility. Certainly, the diversification of the different activities that agro-ecology generally involves allows farmers to compensate for possible crop failures due to adverse climatic and other natural conditions by better results for other crops, or compensate market price reductions for one specific product by more remunerative prices for others (Levard and Apollin, 2013). In this case, agro-ecological farming systems offer in-built systems of insurance for smallholders that make them more resilient to economic, climatic and other natural shocks (Bargout, 2012). The biodiversity offers a buffer against environmental variations because different species respond differently to fluctuations. This situation leads to a more predictable aggregate community or ecosystem properties. This diversity allows the maintenance of a system's functional capacity against potential human management failure that can result from a partial understanding of the effects of environmental change (Lin, 2011). Furthermore, further economic benefits can sometimes result from a better promotion of the production via short circuits (Levard and Apollin, 2013). At the farm level, the evolution of net incomes depends both on variations in the gross income of agricultural activity and on the evolution of production costs generally. When farms adopt or involved more in agro-ecological systems, the gross income largely increases more than production costs, thanks to significant yields increases as suggested by Levard and Apollin, 2013). They propose that this is typically the situation for traditional peasant farms, but that for farms partly or completely industrialized, the situation can be different, at least in the short term, as such farms sometimes face initial declines in yields. They show the agricultural added value tends to increase, often significantly, even when yields are decreasing that in all cases. Definitely,

when such regressions happen, they are often economically compensated by vast decrease in production costs due to the substitution of expensive off-farm inputs by internal solutions to the farming system (Levard and Apollin, 2013).

Increasing the Adequacy of Food by Providing a High-quality Nutritional, Healthy and Culturally Appropriated Food

In contrary to industrial agriculture of the green revolution, nutritionists more and more emphasize the need for more diverse agro-ecosystems for ensuring a more varied nutrient output of the farming systems and so more diversified foods. Agro-ecological farming typically meets this concern, increasing nutritional diversity which is of particular importance to children and women since it promotes extremely diverse cropping systems including with regard to species on the farm (both in rural and urban areas) (De Schutter, 2010a). Agro-ecological farming leads to valorizing and making the best use of traditionally cultivated crops that the Green Revolution style agriculture has underutilized as it is embedded in local cultures. The nutritional value of these crops is high, with ample amounts of micronutrients, antioxidants and essential 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 more vitamin C, iron, magnesium and phosphates and fewer nitrates than conventional crops (Curtis, 2012). The positive impacts of agro-ecological farming on consumer health also result from the reduction to an absolute minimum of synthetic inputs it implies. Moreover, the on-farm recycling of certain wastes of a particular activity contribute to decreasing the release of components such as residues of pesticides, antibiotics and nitrates into the environment that are damaging to the human health (Levard and Apollin, 2013).

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

The access to sufficient water is essential to an adequate standard of living and is acknowledged as a fundamental human right under the Universal Declaration of Human Rights (UDHR) and the International Covenant on Economic, Social and Cultural Rights (ICESCR). According to Chopra (2010), the right to safe and clean drinking water and sanitation as a human right is essential for the full enjoyment of all human rights. As defined by Grey and Sadoff (2007), water security is the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments and economies. However, 780 million people worldwide lack access to clean water, and that 3, 4 million people die each year from water, sanitation, and hygiene-related causes (Water.org, 2012). Water insecurity and scarcity is mainly caused by water pollution from industrial agriculture in many parts of the world (Varghese, 2011). Global warming and population growth in 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 by building healthier soils and improving water conservation and water harvesting in rain-fed regions via various approaches. Adopting and applying agro-ecological farming will therefore be highly valuable for decreasing pressure on water resources, increasing resilience to water scarcity, reducing the frequency of conflicts between competing water uses and, ultimately, contributing to water security and the realization of the Right to Water and Sanitation. This will also enhance food security and the realization of the Right to Adequate Food, thanks to the significant yields increases resulting from higher water productivity and its expected positive economic impacts. Chopra (2010) stated that individuals who lack secure access to water for personal use are very likely to be facing acute or chronic hunger, and vice versa. The right to food also depends on access to water because producing food requires access to adequate water for agriculture (Chopra, 2010). Also, women's access to safe water for domestic use is of highest importance for ensuring household-level food security (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 avoiding overexploiting and contaminating land and

water resources, restoring degraded lands or enhancing soils fertility by increasing SOM (Utviklingsfondet, 2011; Altieri et al., 2012b; Curtis, 2012; Levard and Apollin, 2013). Its principles encourage significant diversification which occurs in many forms and over different scales (Lin, 2011). They further optimize the historical significant contribution of traditional peasant farming systems to the conservation and protection of biodiversity. These principles also invoke addressing local needs thus shortening the circuits of food production and consumption and avoiding the high energy needs of long-distance food (Altieri and Toledo, 2011).

Contribution of Agro-ecology in Increasing Resilience to Climate Change and Addressing the Mitigation Challenge

Promoting agro-ecological farming augments the resilience of farmers to adverse impacts and threats they face as a consequence of global warming, and mitigating GHG emissions resulting from agriculture via a double path: optimizing existing peasant agricultures' resilience to climate change and their mitigation potential, and transitioning industrial agriculture towards more agro-ecological systems primarily with the purpose of mitigating current inputs of agriculture to climate change. This will also contribute to mitigating GHG emissions induced by food systems more largely.

Increasing Resilience to Climate Change

Results from many studies that agro-ecological farming is climate resilient (Li Ching and Stabinsky, 2011; Altieri and Nicholls, 2012). It allows farmers to cope with severe environmental stress whose occurrence are expected to become more frequent because of climate change such as severe droughts and floods, temperatures fluctuations, hurricanes, low precipitation and reduced soil water availability or the invasion of new pests, weeds and diseases (De Schutter, 2010a; Swiderska et al., 2011; Altieri and Nicholls, 2012; Altieri et al., 2012b). For example, many family farmers who have shifted to using green manures and cover crops in Brazil, have experienced lower fluctuations in soil moisture and temperature and a reduction of 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%) confirming the greater resilience of these systems while those practicing conventional agriculture experienced much yield loss (50 %) (Altieri and Nicholls, 2012). Another study in Central American hillsides after Hurricane Mitch in 1998 found that farmers using agro-ecological methods suffered less damage than their conventional counterparts (Altieri et al., 2011a). A study also showed that agro-ecological experimental plots on sustainable farms from southern Nicaragua to eastern Guatemala had an average 40% more topsoil, 69% less gully erosion, higher field moisture and fewer economic losses than control plots on conventional farms (Holt-Giménez, 2002). Results from studies also show that agro-ecological approaches improve recovery after climatic disasters. A survey conducted 40 days after Hurricane Ike hit Cuba in 2008, in the Provinces of Holguin and Las Tunas, for example, found that not only agro-ecologically managed farms exhibited losses of 50% compared to 90 or 100% in neighboring monocultures, but that they also showed a faster recovery (80-90%) than monoculture farms (Rosset et al., 2011). Many others examples exist. The resilience of agro-ecological farming to climate change relies on four main interconnected features or levers: increasing 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); building healthier soils (Li Ching and Stabinsky, 2011; Altieri and Nicholls, 2012; Bargout, 2012); improving water management and water harvesting in rain-fed regions (De Schutter and Vanloqueren, 2011; Li Ching and Stabinsky, 2011; Sahai, 2011; Bargout, 2012); and optimizing yields increases (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% of the total technical mitigation potential of agriculture is related to carbon sequestration, about 9% being linked to mitigation of methane and only about 2% related to mitigation of nitrous oxide emissions 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 residues and reducing tillage to encourage buildup of soil carbon, agroforestry, crop rotations, cover crops, green manures and application of organic amendments such as compost (Li Ching, 201). Promoting and adopting agro-ecological approaches will also significantly contribute to reducing current GHG total emissions of the industrialized food system as a whole, beyond its agricultural component. The reduction and sequestration of one-half to three-fourths of current global GHG emissions can be achieved by adopting four complementary measures: using agro-ecological practices to rebuild the organic matter in soils lost from industrial agriculture; stopping land clearing and deforestation for plantations; distributing food mainly through local markets instead of transnational food chains; decentralizing livestock farming and integrating it with crop production. For example, agro-ecology privileges local markets that shorten the circuits of food production and consumption, henceforth avoiding the high energy needs of 'long-distance food' (Altieri and Toledo, 2011). Also, adoption of agro-ecology can also lead to stopping land clearing and deforestation for plantation because of the significant yields / land productivity increases that its adoption implies. Stopping land clearing and deforestation for agriculture alone can allow a total GHG emissions reduction by 15 to 18 % (GRAIN, 2009b). According to the history, 75 % of deforestation worldwide has been associated with agricultural expansion, industrial animal feed and agro-fuels (CTA, 2012).

Contribution of Agro-ecology in Increasing Peasants' Control over Agricultural and Food Systems

Agro-ecology as a movement also aims to enhance the autonomy and control of peasants over their production systems, therefore contributing to Food Sovereignty which is understood as the right of peoples to healthy and culturally appropriate food produced through ecologically sound and control over their production systems by reducing to an absolute minimum their dependence on off-farm inputs, state subsidies to agrochemicals, local retailers and moneylenders. The increased control of peasants is also due to the bottom-up and farmer-led methods privileged for designing and managing agro-ecological shift processes as illustrated by the CaC methodology. These approaches allow peasants to take responsibility and control over transition processes, enabling them to share, discuss and decide on their own what they want to do (Sen, 2010). However, agro-ecological shifts can also strengthen peasants' control over food systems more broadly via the development of AAFNs and the growing influence on public policy. AAFNs are frequently supportive of and rooted in agro-ecological farming, and seek to decrease reliance on industrialized agri-food systems. The very practice of the alternative model they represent increases farmers', consumers' and other civil society actors' control at various levels. Also agro-ecology as a movement closes links with the solidarity economy that has developed particularly in Latin America in the 1990s in the context of the economic crisis (Nobrega, 2013), while also growing in other parts of the world. In Brazil, which has emerged as a leader of this new movement (Nobrega, 2013), organizations of the solidarity economy have been particularly supportive of agro-ecological farmers, improving the conditions under which they evolve in the market (Fernandez and Gotuzzo, 2012). Lastly, agro-ecology as a movement develops a growing capacity to raise key public policy changes that are needed for promoting agro-ecological approaches at an advanced stage, even though challenges to be met in this regard are enormous and meeting them require long term 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 range of policies and practices that have in history disadvantaged peasant agricultures in many national, regional and international contexts. Addressing these obstacles on the long term is crucial to release the remarkable sustainability potential that peasant agricultures hold traditionally. This potential can intensely increase via an agro-ecological modernization which combines traditional knowledge and know-how with modern agro-ecological science (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 often work in the most degraded farming areas, have lower incomes for buying expensive inputs with lower access to credits, thus meeting more difficulties in accessing external inputs and subsidies (De Schutter, 2010a; Curtis,

2012). Agro-ecology empowers women by making them the innovation leaders for achieving sustainability (Tripathi at al., 2012). Agro-ecological approaches have a big potential to empower women when they are properly conceived and managed. This empowerment can happen by helping women to be well aware of the challenges and difficulties 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 each other to follow new paths, break barriers, and are encouraged to leave many of their fears behind. Systematizing women's experiences is an important tool for empowerment, as well as an efficient strategy for deconstructing and denaturalizing men's dominance over women (Lopes and Jomalinis, 2011). Agro-ecological perspective allows collective action by putting women in their only groups. Such groups provide enabling spaces where marginalized women can gain self-esteem, confidence and skills. They are very efficient in allowing them to identify their needs, understand their rights and begin to formulate their demands. But, women's involvement in mixed groups can also 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 actively empower themselves by playing a key role as advocates for change, just as any other vulnerable and marginalized group can do. In India, for example, thousands of women have been advocating for the insertion of millets in the definition of food grains in the National Food Security Bill and the decentralized public distribution system, in the framework of a campaign developed by the Deccan Development Society (DDS) and the Millet Network of India (Tripathi et al., 2012).

4. 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, breaking with cycles of policies which all too often have disadvantaged peasant agricultures and agro-ecology, such as mainstream trade and agricultural policies including the structural adjustments programs of the International Monetary Fund and the World Bank, and the Agreement on Agriculture of the World Trade Organization , and with the current trends in agricultural reinvestments which tends to consolidate industrial agriculture through the reformist agenda of sustainable intensification (De Schutter and Vanloqueren, 2011). From experience, adequate support and investment from the State can lead to efficient promotion and adoption of agro-ecology.

5. 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 threatening 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 increasing incomes for small and mid-scale producers (especially women) while increasing resilience to climate change and addressing mitigation challenges. It, therefore, permits to feed the world sustainably.

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