# Agricultural Challenges in Less Developed Country: A solution-based approach

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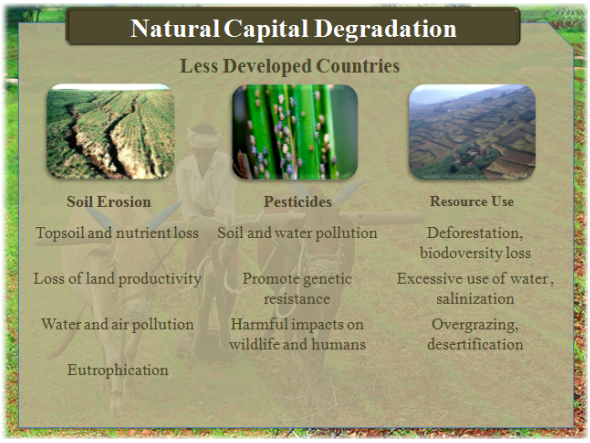
## 1. Introduction




In the last 10,000 years, humans have evolved from hunter-gatherers to develop more sophisticated agriculture systems. Since, developed nations have enjoyed the benefits of increased technology to generate the highest crop yield using industrialized agriculture. However, most of the less developed countries (LDCs) still rely on traditional agriculture learned years ago. This form of agriculture relies on low-input of resources, often growing multiple crops on the same plot of land. In fact, 2.7 billion people in LDCs practice traditional agriculture (Miller & Spoolman, 2012). With one in six people in LDCs not getting enough to eat, agriculture plays a large role in food production in these countries (Miller & Spoolman, 2012). Agriculture supports economies in LDCs where employs up to 85% of the workforce (Tamene & Vlek, 2008). Many problems face local farmers: soil erosion, use of pesticides, and resource use. However, there are solutions particular to LDCs that can prevent harmful environmental, economic, and health impacts.

## 2. Resource Use and Land Degradation

Land exploitation from agriculture transforms and impacts its natural environment. Unsustainable use of resources due to a larger need of food production from agriculture can impact the environment, degrade the land, and affect the productivity of the land. The long term effect can be that less land will be useable for agricultural purposes, worsening the problem of sustaining food security in less developed countries (Kahn & Shah, 2010).

### 2.1 Deforestation

In order to use land for agriculture, forests or other natural land that provides us with natural capital and services needs to be converted. In the so called “slash and burn” agriculture, small plots in tropical forests are cleared. Thereafter, the land is used for growing crops until the soil no longer contains any nutrients, at which point, the whole operation starts over again (Miller & Spoolman, 2012).

In the process of clearing forest habitats, wildlife can be destroyed or fragmented, thus affecting biological diversity. In addition, the many ways agriculture impacts the environment can lead to physical, chemical and biological degradation of the environment that negatively affects biological diversity (Verhagen et al 2007). Moreover, clearing of forests reduces the Earth’s natural ability to adsorb carbon dioxide from the atmosphere, adding to the warming of the atmosphere.

### 2.2 Water usage

According to Miller: agriculture is responsible for 70 % of the water humanity uses (2012). In addition 60 % of the water that is used for irrigation does not reach the targeted crops. Common wasteful ways to irrigate crops utilized in less developed countries are flood irrigation or irrigation ditches. This can lead to salinization of the soil. In addition, agriculture can put added stress on often limited resources of ground- or freshwater, and unsustainable use of shared water resources can also lead to local or regional conflicts (Miller & Spoolman, 2012).

Soil salinization is an environmental problem that has existed for a long time, especially in semiarid regions of the world. Salinization caused by irrigation, is the result of excess water not utilized by the crop evaporating and leaving behind a thin crust of mineral salts (Miller & Spoolman, 2012). The conversion of natural land by agriculture can also cause salinization when changes in evaporation

increases groundwater recharge, bringing soluble salts closer to the surface (Wang & Li, 2013). The salinization of the soil will impact its productivity, and therefore its suitability for agriculture.

### 2.3 Overgrazing

Overgrazing means that grasslands etc are exposed to intense grazing without sufficient periods to recover. In addition to directly affecting the animals, the loss of vegetation cover can result in soil erosion, land degradation and desertification. (Li-Bo et al).

The extent of the world's deserts have shifted over thousands of years mostly due to natural changes in natural climate. Desertification, however is the loss of productive potential in the topsoil due to drought and human activities combined (Miller & Spoolman, 2012). Deforestation is another activity that affects the likelihood of desertification (Verhagen et al 2007). The effects of desertification can be different degradation of the land such as salinization of the soil, soil erosion by water or wind etc.

## 3. Soil Erosion

Agriculture disturbs land surface, exposing topsoil that is vulnerable to erosion from water and wind. Soil erosion is defined as the transport of soil components – including surface plant matter and topsoil – from one location to another (Miller & Spoolman, 2013). LDCs face greater economic ramifications due to soil erosion because often countries lack the capacity to cope, prevent, or restore soil nutrients (Tamene & Vlek, 2008). Some soil erosion is natural and expected. However, excessive erosion depletes topsoil nutrients, reduces soil fertility, and leads to pollution of air and waterways (Miller & Spoolman, 2013).

Many factors contribute to soil erosion including farming, deforestation, grazing, drought, etc. In assessing topsoil erosion, scientists can estimate the amount of topsoil erosion by taking into account the location's average rainfall, type of soil, the length and slope of the field, and land management practices (Institute of Water Research, 2002). For example, scientists can estimate that soil loss in Ethiopia is approximately 42 tons per hectare per year ($t\ ha^{-1}\ yr^{-1}$) (Tamene & Vlek, 2008). To put this into context: one ton of soil lost annually per hectare over a 50-100 year period is considered unsustainable and irreversible (Institute of Water Research, 2002). Many LDCs – including Ethiopia – see many times greater amounts of soil erosion.

### 3.1 Loss of Productivity

Land requires fertile topsoil in order to be agriculturally productive. However, topsoil erosion from wind and water removes valuable nutrients like carbon, nitrogen, and phosphorus needed in crop production. It is estimated that for every millimeter of topsoil lost in Africa, there is a corresponding 2-5% reduction in crop yields (Lal, 1995). Moreover, in parts of Ethiopia and other African countries, areas have seen a 50% reduction in crop yield due to erosion (Tamene & Vlek, 2008). Once topsoil is removed, it may take 100 years or more for a new layer of topsoil to form (Miller & Spoolman, 2012).

### 3.2 Sediment & Waste

Among the eroded material, sediment from the topsoil may enter waterways and air due to runoff and wind (Miller & Spoolman, 2012). Sediments act as the primary carrier of other pollutants like organic waste, fertilizers, pesticides, and heavy metals (Novotny, 1999). When sediments and other pollutants enter waterways, they can lead to the degradation of aquatic habitats by depleting oxygen, reducing photosynthesis capabilities, and depositing material on the floor of the waterway (Novotny, 1999). Sediment can kill fish, overload irrigation canals, and pollute drinking water (Miller & Spoolman, 2012). Also, animal waste applied as organic fertilizer or from livestock is transported via runoff carrying fecal coliform bacteria including E. coli. Polluted waterways in LDCs are especially damaging when more than 1 billion people don't have access to clean drinking water and 1.6 million die annually from waterborne illness (Miller & Spoolman, 2012).

## 4. Pesticides

Another challenge that both the developed countries and the LDCs are facing: the harmful and polluting effects of the use of pesticides. With the development of agriculture the use of pesticides has significantly increased, more than 50 fold in 60 years, but most pesticides that are used today are 10-100 times more toxic than those used in the 1950's and can harm both wildlife and humans. (Miller & Spoolman, 2012)

### 4.1 Impacts on the environment and humans

According to the WHO and UNEP each year pesticides seriously poison at least 3 millions agricultural workers in LDCs. Pesticides are also dangerous to people that are not directly in contact with them but who through water of food ingest them, as it has been seen in India, where 23 school children died after eating a meal containing a highly dangerous pesticide. (FAO, 2013)

Pesticides do not stay put, according to the USDA, 98-99.9% of the insecticides applied by aerial spraying or ground spraying do not reach the target pests and end up in the air, surface water, groundwater, bottom sediments, food and nontarget organisms. (Miller & Spoolman, 2012, p298)

Therefore they pollute the environment and disturb ecosystems by killing natural predators and parasites that help control the pest populations or sometimes keystone species in the ecosystem (i.e honeybee) or simply promote genetic resistance. In LDCs, poor application of fertilizers and pesticides are seen as a culprit in damaging soil quality and groundwater supplies.

### 4.2 Economic and social consequences

The most dangerous pesticides that have been banned in most of the developed countries are still largely exported to LDCs. The use of pesticides banned in industrialized countries, in particular, highly toxic pesticides as classified by WHO, obsolete stockpiles and improper storage techniques may provide unique risks in the developing world. (WHO, 2008)

Pesticide use in LDCs is linked to acute and chronic illness, suicide attempts, occupational poisoning, and lead to significant mortality and morbidity. Pesticide-related illnesses cause a loss of labor productivity in those countries where the agriculture sector is crucial. Households can be pushed into poverty or forced into deeper poverty when faced with substantial medical expenses, particularly when combined with a loss of household income due to ill-health. (Atreya et al, 2010, p57)

## 5. Solutions / Conclusion:

Even in less developed countries, prevention of soil erosion / runoff and reduction in resource use is possible through simple land management practices. Through local initiatives and education, farmers can control many harmful impacts of agriculture. Soil conservation practices like strip (planting rows of alternating crops) or contour (planting crops that run parallel to the natural slope) cropping can reduce the impacts of erosion and runoff of harmful pollutants (Miller & Spoolman, 2012). Moreover, crop rotation can play a vital role in replenishing soil nutrients. It is important to alternate nutrient depleting crops like cotton and corn with other, less degrading crops. Legumes – such as soybean and alfalfa – have the ability to fix nitrogen aiding in nutrient cycling and replenishing soil nutrients (Miller & Spoolman, 2013). In less developed countries, plant and animal waste that may otherwise pollute waterways can be used in moderation as organic fertilizer returning nutrients to the soil (Miller & Spoolman, 2012). Also, efficient irrigation practices like drip irrigation targets crops more effectively (Miller & Spoolman, 2012). Many of these practices make up what is called organic farming.

A United Nations Environmental Programme (UNEP) study found that on those farms in less developed countries that implemented organic farming, crop yields doubled (Miller & Spoolman, 2012). Organic farming decreases the impacts of climate change, decreases the need for pesticides, water use, and energy consumption (Miller & Spoolman, 2012). However, prevention is key and now is the time to act. With the threat of climate change mounting, increased droughts and persistent flooding may threaten agriculture in

less developed countries. Moreover, by 2050, 200 to 600 million people may face starvation due to climate change, primarily those in less developed countries (Miller & Spoolman, 2012).

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