Increasing pressure on land

Widespread hunger and rising global food demand necessitate better use of the world’s water, land, and ecosystems. For a world population of about 9 billion in 2050, agricultural production has to increase by 70 percent globally and to double in developing countries. An enormous effort is required to achieve such growth. Some 16 Mkm² of land are currently used for crop production, about 10 Mkm² are under cultivation in developing countries. As people strive to get the most out of land or exploit virgin territory to develop more agricultural land, the damage inflicted on the environment grows. Up to 40 percent of the world’s arable land is degraded. An already difficult food insecurity situation is made worse by the increasing effects of climate change. While current research confirms that crops would respond positively to elevated CO₂ in the absence of climate change, higher temperatures, altered precipitation patterns, and increased frequency of extreme events will likely depress agricultural yields and increase food production risks in many of the current food-insecure countries.

Methods and Results

The Food and Agriculture Organization of the United Nations (FAO) with the collaboration of IASA, has developed a system that enables land planning on the basis of an inventory of land resources and evaluation of biophysical limitations and production potentials of land. This is referred to as the Agro-ecological Zones (AEZ) methodology.

New comprehensive global information (GAEZ v3.0) is a milestone for the improvement and dissemination of knowledge about current and future productivity potentials of land. GAEZ helps identify land and water limitations and provides insight in current yield and production gaps and their causes.

Global land resources suitable for agricultural production were estimated to comprise at least 3.1 Gha of arable land (including 22 Mkm² grassland, woodland and forest land), and 11 Mkm² of marginal land (of which 8 Mkm² is grassland, woodland and forest land).

Very clearly, a large part of the suitable land is already in use or is not available for crop production due to its nature protection status (about 6 Mkm²), its carbon and biodiversity value (some 15 Mkm² of forest assessed as suitable for crops), and because of its current use for feeding a large part of the world’s 3.5 billion ruminant livestock.

Prime and good resources for agriculture on a per capita basis are plentiful in only a few regions, foremost Australia, South America, North America, and Eastern Europe. Russia. There is little in Europe, and in Asia and Africa this countries will have to achieve other solutions to overcome resource scarcities with technological improvements and efficiency gains through improved management of land and water resources.

The remaining global land balance, some 78 Mkm², was assessed not suitable for crop cultivation due to poor soils, steep slopes and/or areas that are too dry or too cold. Of this, about 34 Mkm² is barren, bushed-up or water, and 18 Mkm² is forest. Of some 26 Mkm² of grassland/woodland not suitable for crop production, 16 Mkm² is unproductive land (below 0.2 t/ha dry matter) and the remainder, about 10 Mkm², can produce some herbaceous biomass that can support ruminant livestock at an extreme level (yields mostly in the range 0.2–0.6 t/ha dry matter).

Main Messages and Policy Conclusions

- From a resources point of view it is possible to produce enough food for a projected 9 billion population in 2050 at global level; yet, one cannot ignore disparities across and within regions. For countries with a limited resource base and large projected population growth, efforts to develop agriculture need to be supplemented with interventions in other sectors.
- Per capita availability of prime land resources is plentiful in only a few regions. Yield gaps, technological improvements and efficiency gains will be needed to allow development. Overall there is much lower productivity of crops in potentially available grass/woodland and ecosystem than in currently cultivated land.
- To prevent widespread land conversion and reduce the greenhouse gas and environmental effects of deforestation, the required agricultural production to 2050 should largely be achieved on current cultivated land and pasture land, which means an enormous effort for farmers, agricultural researchers, irrigation development, fertilizer industry and infrastructure for inputs and market accessibility. It is uncertain whether an 1.4% average annual yield growth can indeed be achieved and sustained over 50 years.
- Soil nutrient availability is by far the most prevalent soil limitation in most regions. When combined with low nutrient retention capacity of soils, fertilizers alone may prove less effective for increasing crop yields, notably in tropical regions, requiring also strategies of integrated plant nutrient management.
- Within the context of ‘land grabbing’, information on the agro-ecological potentials of land (e.g. such as provided in GAEZ v3.0) combined with participatory land use planning is key to the principle of responsible investment strategies for sustainable and mutually beneficial development.
- While the global balance of crop production potential of the current cultivated land is not much affected by climate change in the next decades, there are several regions where climate change poses a significant threat for food production and food security. Scenario results confirm that, with and without CO2 fertilization, the impacts of projected climate change on crop yields and production could become severe in the second half of this century.

Water scarcity

Compounding food insecurity is water scarcity in the locations that need it most. Scarcity of water resources already face water shortages, and by 2050 this number could increase to over 50 countries, most of the developing world. With the majority of the world’s food production, water use in agriculture is scarcity is often a very serious obstacle to achieving food security.

About one fourth of the world’s population lives in areas categorized as physically water scarce and one sixth in areas of economic water scarcity (United Nations, 2006). Agriculture is the largest user of water among human activities. Irrigation water withdrawals are 70 percent of the total anthropogenic use of renewable water resources. Irrigated crops account for about 40 percent of total crop output.

While the globe has the required freshwater resources to satisfy the needs of the population on average, the resources are very unevenly distributed, with some countries having an abundance while many manage water conditions of extreme scarcity.

Ways forward

- Commitment to sustainable agricultural development: Agriculture is the key driver of the environment and natural resources, it has the greatest impact on the sustainability of ecosystems and their services, and accounts directly and indirectly for a major share of employment and livelihoods in rural areas in developing countries. The reality for many developing countries is that no progress on reducing rural poverty and hunger can be achieved without political and resource commitment to sustainable agricultural development.

- However, trends over the last 50 years show a reduced allocation of national development budgets to agriculture in many developing countries, a setback that has coincided with declining multilateral lending and bilateral aid for the sector due to low prioritization by national governments and their international partners.

- Providing adequate rights to access to land and other natural resources and secure tenure of those rights are essential to fostering sustainable and progressive agricultural development. Farmers are quite naturally inclined to invest in improving their land through soil protection measures, planting trees, and improving pastures if they have secure tenure and can benefit from their investments.

- Development of adequate infrastructure for both transport and communication will help farmers to access required inputs such as fertilizers and pesticides and produce for distant markets.

- Land and water uses for food production regularly compete with other ecosystem services. Ignoring such resource use conflicts and tradeoffs can lead to unsustainable exploitation, environmental degradation, and avoidable long-term societal costs. Overcoming this limitation requires better understanding and management of competing uses of land, water, and ecosystem services, including robust expansion of food and bio-energy production, sustaining regulating ecosystem functions, protecting and preserving global gene pools, and enhancing terrestrial carbon pools.