Meeting the SDG challenges

Widespread hunger and rising global food demand necessitate better use of the world’s finite resources. In 2050, agricultural production has to increase by 70 percent globally and to double in developing countries. An enormous effort is required to achieve this growth.

Commodifying food insecurity is water scarcity in the locations that need it most. Some 30 countries already face water shortages, and by 2050 this number has increased to over 50 countries, mostly in the Middle East and North Africa. With the majority of the world’s fresh water use going to agriculture, water scarcity is often a very serious obstacle to achieving food security. Agriculture is the largest user of water among human activities. Irrigation water withdraws account for 70 percent of the total anthropogenic use of renewable water resources. Irrigated crops contribute about 40 percent of total crop output.

An already difficult food security situation is made worse by the overarching 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 intensity of extreme events will likely depress agricultural yields and increase food production risks in many of the current food-insecure countries.

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

New GAEZ v4 system

New comprehensive global information (GAEZ v4.0) is a milestone for the improvement and dissemination of knowledge about current and future alternatives of land and water resources use.

GAZE Products and Results

GAZE information is of critical importance for national resource management, guiding effective land use changes, making responsible investments in land and water development, and for achieving progress towards sustainable agricultural development, especially with regard to global climate change and the need for adaptation and mitigation in the agricultural sector.

The potential for sustainable intensification of agricultural production has been assessed by estimating location specific yield and production gaps between actual achieved and potentially achievable yield and production of cereals, roots and tubers, pulses, sugar crops, oil crops and vegetables. The analysis employs spatially explicit ("downscaled") agricultural statistics of year 2010 and 2050 and compares these with potentials simulated for the baseline climate.

Results of the analysis suggest that on average the achieved crop yields equal to just over 50% of potentially achievable yields, with large variations across regions. In sub-Saharan Africa yields are lower by a factor 4 compared to potential. Also in Eastern Europe and the countries in Central Asia large yield gaps and underutilization of land prevail. In Northern America, East Asia and Oceania apparent yield gaps are moderate, and yield gaps are smallest in Western and Northern Europe.

Main Messages and Policy Conclusions

• To prevent widespread land conversion and reduce the greenhouse gas and environmental effects of deforestation, the required agricultural production increases to 2050 should largely be achieved on current cultivated and pasture land, which means enormous potentials for 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.

• With the context of land grabbing, information on the agro-ecological potential of land (e.g. such as provided in GAEZ v4.0) 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.

Ways forward

• Commitment to sustainable agricultural development: Agriculture is the dominant user of the environment and natural resources, it has the greatest impact on the sustainability of ecosystems and their services, and accounts for nearly 80% of 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, even over the last 30 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 priority allotted by national governments and their international partners.

• Providing adequate rights of access to land and other natural resources and secure tenure of those resources are essential to fostering sustainable and progressive agricultural development. Farmers are quite naturally more 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 as well as to target production for local markets.

• Land and water uses for food production regularly compete with other ecosystem services. Ignoring such 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.

Policy Support for Sustainable Development: Scarcity, Abundance and Alternative Uses of Land and Water Resources

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