Modernization of Agricultural Production

Mahmoud Fadl el Mula Ahmed
Agronomy Department, Faculty of Agriculture, University of Khartoum.
E-mail: mfahmed@yahoo.com

Abstract: Sub-Saharan Africa (SSA) is projected to increase its population to more than double—from 1.1 billion people to 2.4 billion—by the year 2050. However, over the past several decades, the region has experienced a decline in food production per person. In order to feed the world’s growing population, agricultural productivity will need to improve. Agricultural productivity is largely a reflection of poverty. In Malawi, for example, 80 percent of the population works in agriculture, though agriculture accounts for only 36 percent of the country’s GDP. About 25 percent of the population exhausts their food supply just 5 months after harvest, and most rural families do not have enough land to produce sufficient food or have the sufficient money to purchase more land. Similarly, 50 percent of the population of Kenya’s Western Province lives below the poverty line. Though the farmers grow maize, they are typically net purchasers of the crop, and have to purchase more maize just before the harvest, as the food supply is exhausted. The World Bank explains that agricultural productivity is important for reducing poverty, even for people who are not farmers. The overall cost of food, employment opportunities and wages, and sectors of the economy that interact with the agricultural sector all depend on agricultural products. Agriculture meets a major human need and both affects and depends on all other life support systems. Current trends point to continued human population growth and ever higher levels of consumption as the global economy expands. Agriculture’s main challenge for the coming decades will be to produce sufficient food and fiber for a growing global population at an acceptable environmental cost. This challenge requires an ecological approach to agriculture that is largely missing from current management and research portfolios. Crop and livestock production systems must be managed as ecosystems, with management decisions fully informed of environmental costs and benefits. Globally, the 5 billion hectares under agricultural management exceeds the area covered by forests and woodlands, and some 13 million hectares are annually converted to agricultural use, mainly from forests, yet as human enterprise agriculture is fundamentally a social endeavor shaped by market forces, social and economic policy, and human values. Thus, the future adequacy and environmental impact of agriculture depends on how effectively we understand and manage the technical, social and ecological elements of agricultural ecosystems in order to modernize the low productivity, especially among small holders, aiming at boosting crop productivity.

Key words: agricultural productivity, ecological approach, poverty, global, modernization, is boosting.
INTRODUCTION

Sub-Saharan Africa is set to more than double its population—from 1.1 billion people to 2.4 billion—by the year 2050. However, over the past several decades, the region has experienced a decline in food production per person. In order to feed the world’s growing population, agricultural productivity will need to improve. Agricultural productivity is largely a reflection of poverty. In Malawi, for example, 80 percent of the population works in agriculture, though agriculture accounts for only 36 percent of the country’s GDP. About 25 percent of the population exhausts their food supply just 5 months after harvest, and most rural families do not have enough land to produce sufficient food or have the sufficient money to purchase more land. Similarly, 50 percent of the population of Kenya’s Western Province lives below the poverty line. Though the farmers grow maize, they are typically net purchasers of the crop, and have to purchase more maize just before the harvest, as the food supply is exhausted. The World Bank explains that agricultural productivity is important for reducing poverty, even for people who are not farmers. The overall cost of food, employment opportunities and wages, and sectors of the economy that interact with the agricultural sector all depend on agricultural productivity (Restuccia, et al, 2008).

As a general rule, small farmers prefer to engage in less risky agricultural techniques, while farmers with more land and capital can afford to use labor-saving but potentially risky techniques. It is costly to be an early adopter of any new agricultural technique, especially in Sub-Saharan Africa, where micro-climates necessitate experimentation. As a result, the adoption of useful agricultural technology may lag behind. In Western Kenya, for example, only 37 percent of farmers have ever used chemical fertilizers. The levels of fertilizer use recommended by the Kenyan Ministry of Agriculture also contribute to low fertilizer use in the region. According to a study by Innovations for Poverty Action, recommended fertilizer levels did not yield enough crop to offset the cost of fertilizer. However, lower fertilizer use still dramatically increased yield—as much as 63 percent. Modernization of agriculture is a process of transforming agriculture from traditional labor-based agriculture to technology-based agriculture (Timmer, 1988). It is one of the fundamental issues in agricultural policies, particularly in countries, where agriculture is less developed.

In the past 50 years, global crop production has expanded three fold. This increase has been driven largely by higher yields per unit of land, and crop intensification resulting from multiple cropping and/or shortening of fallow periods. The expansion of arable land area allocated to crops has played a less important part in production increases. However, these trends are not uniform across regions.

For instance, most of the growth in wheat and rice production in developing countries in the land-scarce regions of Asia and Northern Africa has been the result of gains in yield, while expansion of harvested land is behind the rapid production growth of maize in Latin America and the Caribbean and in Sub-Saharan Africa. Yield growth contributed only one-third of the increase in crop production in the latter region. Over the past half century, global arable land increased by 67 million hectares, as a result of two opposing trends: an increase of 107 million hectares in developing countries and a decline of 40 million ha in developed countries. Shetty, (1990) stated that the arable land area in developed countries peaked in the mid-1980s, and has fallen at an accelerating rate ever since.

Major forces shaping the location and extent of crop production in the long term include land scarcity, access to technology, security of tenure, and social conditions such as gender-based...
rules and norms. Improved agro-ecological practices have combined with the availability of new technologies to promote commercially viable agricultural production.

For cereals, which occupy more than half of the world’s harvested area, the slow down in yield growth has been pronounced, dropping from 3 percent per annum in the 1960s to just over half that amount in the 1990s, before rising back to almost 2 percent in the last decade.

Growth in global yields of other staples, such as pulses and root crops, has been much smaller – at well under 1 percent per annum over the past five decades. In contrast, yield growth in oil crops has been particularly dynamic, at about 3 percent per annum – the highest for any crops over the period (Rath, 1989).

ICT and Farmer Development

Information and communications technology has revolutionized development. Increased financing, privatization and market liberalization, which are the result of increased global integration, have led to greater access.

Mobile telephone and the Internet have become essential tools in development, and developing countries’ share in these tools has become increasingly significant over time. Between 2005 and 2010, developing countries’ share of worldwide mobile telephone subscriptions increased from approximately 50 to 75 percent.

Mobile technology is especially important for farmers and people living in rural areas. Most of the next billion mobile subscribers will most likely be rural poor. For innovation to occur, investments in research and development (R&D) must take place, including within agriculture. Systematic data on agricultural R&D spending are essential, to identify areas where investment can lead to increased agricultural productivity and – ultimately – greater food security.

The Agricultural Science and Technology Indicators (ASTI) global assessment of agricultural R&D spending reported that between 2000 and 2008 agricultural R&D investments were on an upswing (Chavas, 2011). Following a decade of slowing growth in the 1990s, global public spending on agricultural R&D increased steadily from US$26.1 billion in 2000 to US$31.7 billion in 2008.

Most of this increase was driven by developing countries. China and India accounted for close to half of the global increase of US$5.6 billion, but other countries – particularly Argentina, Brazil, the Islamic Republic of Iran, Nigeria and the Russian Federation – also significantly increased their spending on public agricultural R&D. These trends mask the negative developments that have taken place in numerous smaller, poorer and more technologically challenged countries, which are often highly vulnerable to severe volatility in funding and often see the continuity and viability of their research programs deteriorate.

In addition to financial challenges, many R&D agencies in these countries lack the necessary human, operating and infrastructural resources to develop, adapt and disseminate successful science and technology innovations.

Gardner (2002) reported that agricultural technology can help reduce poverty through direct and indirect effects. Direct effects are gains for the adopters while indirect effects are gains derived from adoption by others, leading to lower food prices, employment creation, and growth linkage effects. Conceptualizing and measuring these effects is highly complex, yet is needed for each region if technology is to be used as an effective instrument for poverty reduction. With increased availability of useful agricultural technologies and systems to help farmers adopt them, agricultural productivity can improve to help combat poverty (Marks, 2011).
INPUTS

Throughout Asia and in parts of Latin America, expanding seed and fertilizer use has been accompanied by investments in irrigation, rural roads, marketing infrastructure and financial services, paving the way for dynamic commercial input markets. Developing such markets is essential for agricultural productivity growth. Where data gaps currently exist, having more gender-disaggregated information for inputs could lead to more effective policies for achieving this end (Heilig, 1999).

Machinery is a major input in agriculture and can improve efficiency. Agricultural tractors are generally wheel- and crawler or track-laying tractors (excluding garden tractors) used in agriculture.

Today, Asian farmers are major users of fertilizers. One-third of the increase in cereal production worldwide and half of the increase in India’s grain production during the 1970s and 1980s have been attributed to increased fertilizer consumption. The use of fertilizers is becoming even more crucial in light of such factors as the impact of more intensive cultivation practices and shorter fallow periods on soil fertility. An increased use of chemical fertilizers and other agricultural technologies will likely improve agricultural yields dramatically, and thus benefit farmers and their communities. Additional agricultural technologies that are likely to improve income for farmers are also being developed.

Fertilizer consumption measures the quantity of plant nutrients used per unit of arable land. Misuse of fertilizers can lead to negative results on the environment and on farmers’ health. Pesticides can also increase agricultural productivity. Pesticides are the insecticides, fungicides, herbicides, disinfectants and other substances or mixtures of substances used to prevent, destroy or control any pest.

Pesticides also include substances intended for use as plant growth regulators, defoliants, desiccants or agents for thinning fruit or preventing the pre-mature fall of fruit, and substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport. When pesticides are handled improperly, they are toxic to humans and other species. Usage can be reduced through integrated pest management (IPM), which uses information on pest populations to estimate losses and adjust pesticide doses accordingly. IPM has brought tremendous benefits to farm profitability, the environment and human health.

Adoption has often been limited because of its complexity, but results can be extraordinarily successful. In Eastern Africa, for instance, the cassava mealy bug – which caused significant losses – was successfully controlled by introducing a parasitoid wasp that is the mealy bug’s natural enemy.

What Global Perspectives do we need?

— Agriculture is a global enterprise, and the need for sustainable solutions to pressing environmental and production challenges is acute almost everywhere.

— Many solutions will be crop- and region-specific, although the principles on which individual solutions are based will be universal.

— Global research networks can be a powerful means for testing principles across biomes and eco-regions.

— The Consultative Group of International Agricultural Research (CGIAR) has been supporting research on natural resource management for decades.
This system of international research centers has redefined its original focus on food production and rural livelihoods so as to also embrace the provision of international public goods.

Current priority research areas include soil carbon and plant nutrition, water quality and quantity from a watershed perspective, water as a habitat for living aquatic resources, forests for both timber and non-timber forest products.

Master et al., (1998) reported that one major class of environmental benefit for which the CGIAR takes credit is liberating an estimated 230–510 million hectares of land that would have been required for global food production in the absence of agricultural productivity gains from CGIAR research.

Socioeconomic settings, like biophysical settings, vary greatly across the globe but most of the ecological principles and some of the technical solutions developed ought to be relevant to small holdings as well as intensive cropping.

Failure of these principles or solutions will be destructive.

Constructive work by the CGIAR and collaborating agricultural scientists is underway.

Part of that work involves developing technologies to improve natural resource management, both preventing negative outcomes, such as soil erosion and water pollution, and enhancing positive ones, such as sequestering carbon and boosting food productivity.

Another part of this work involves experimenting with participatory research and outreach methods that engage local community members in making resource-management decisions by which they will have to abide.

There are few places in the world today where agriculture can be termed sustainable. The need to test principles and to develop and deploy solutions is universal, and global research partnerships will surely help to accelerate the sustainability transition for agriculture.

In the past, most research on management of agriculture and natural resources has been conducted by scientists from the agricultural disciplines.

Increased involvement of multidisciplinary research would enrich the mix and potentially lead to new breakthroughs (Wang, and Xie, 2004).

Consider these 9 tips, techniques, and methods regarding how to increase your crop productivity:

1. Plant Early, Plant Effectively
2. Adopt Appropriate Technology
3. Practice Seasonal Soil Rotation
4. Know The Yield Potential
5. Always Scout Your Fields
6. Ensure Proper Water Drainage
7. Use Appropriate Fertilizers
8. Test Your Soil Frequently
9. Weed Early and Often
WHAT ARE THE RESULTS OF INAPPROPRIATE MODERNIZATION OF AGRICULTURE

Advantages of modern agriculture

During the latter half of the twentieth century, what is known today as modern agriculture was very successful in meeting a growing demand for food by the world's population. Yields of primary crops such as rice and wheat increased dramatically, the price of food declined, the rate of increase in crop yields generally kept pace with population growth, and the number of people who consistently go hungry was slightly reduced. This boost in food production has been due mainly to scientific advances and new technologies, including the development of new crop varieties, the use of pesticides and fertilizers, and the construction of large irrigation systems.

Disadvantages of modern agriculture

Evidence indicates, however, that excessive reliance on monoculture farming and agroindustrial inputs, such as capital-intensive technology, pesticides, and chemical fertilizers, has negatively impacted the environment and rural society. Most agriculturalists had assumed that the agroecosystem/natural ecosystem dichotomy need not lead to undesirable consequences, yet, unfortunately, a number of "ecological diseases" have been associated with the intensification of food production. They may be grouped into two categories: diseases of the ecotope, which

...
include erosion, loss of soil fertility, depletion of nutrient reserves, salinization and alkalinization, pollution of water systems, loss of fertile croplands to urban development, and diseases of the biocoenosis, which include loss of crop, wild plant, and animal genetic resources, elimination of natural enemies, pest resurgence and genetic resistance to pesticides, chemical contamination, and destruction of natural control mechanisms.

Chemical fertilizers can also become air pollutants, and have recently been implicated in the destruction of the ozone layer and in global warming. Their excessive use has also been linked to the acidification/salinization of soils and to a higher incidence of insect pests and diseases through mediation of negative nutritional changes in crop plants. Use of fertilizers can alter the biology of rivers and lakes. Applied in either liquid or granular form, fertilizer can supply crops with readily available and uniform amounts of several essential plant nutrients. Fertilizers, on the other hand, have been praised as being highly associated with the temporary increase in food production observed in many countries. National average rates of nitrate applied to most arable lands fluctuate between 120-550 kg N/ha. But the bountiful harvests created at least in part through the use of chemical fertilizers, have associated, and often hidden, costs. A primary reason why chemical fertilizers pollute the environment is due to wasteful application and the fact that crops use them inefficiently. The fertilizer that is not recovered by the crop ends up in the environment, mostly in surface water or in ground water. Nitrate contamination of aquifers is widespread and in dangerously high levels in many rural regions of the world. Such nitrate levels are hazardous to human health and studies have linked nitrate uptake to methaemoglobinemia in children and to gastric, bladder and oesophageal cancers in adults.

CONCLUSIONS
— Agriculture must adopt a more forward-looking, systems-oriented outlook towards its environmental and social footprints.
— Agronomists must embrace ecology and ecologists need to become more involved in thinking about agricultural systems
— Both must be willing to work with economists and other social scientists to appropriately identify services that can boost productivity
— Finally, the public must be prepared to evaluate trade-offs among these services and enact change.
REFERENCES