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Perspectives on Food Crop Production for Combating Famine in Ethiopia

Brhane Gebrekidan
Amhara Micro-enterprise development, Agricultural Research, Extension and Watershed Management (AMAREW) Project,
amarew@telecom.net.et

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Brhane Gebrekidan, (**A**mhara **M**icro-enterprise development, **A**gricultural **R**esearch, **E**xtension and **W**atershed management: **AMAREW)** Project, e-mail amarew@telecom.net.et, P.O. Box 61, Bahir Dar, Ethiopia

ABSTRACT

Feeding the ever-growing Ethiopian population with the continuously shrinking land holdings and nutrient depleted soils is going to be very difficult to say the least. The realistic option under the current Ethiopian scenario is to increase the food productivity per unit of land. The science and the technological options available to realize higher productivity than what the average Ethiopian farmer gets are widely available both locally and internationally. Assuming that all of the non-technical instutional and policy issues bearing on solving the famine problem in Ethiopia are addressed adequately, my perspective focuses on the technological options to curtail famine and malnutrition in the country.

A modern and high yield productive system in Ethiopia should contain the following:

· Best quality improved seed of the best available cultivars suitable for the ecological zone under consideration
· Application of the right kind and amount of chemical fertilizers
· Utilization of adequate amount of water either through rain or irrigation
· Proper farm power and implements
· Optimum land and seedbed preparation
· Proper cultural practices including planting date/rate/depth and row planting
· Timely and proper weed control
· Crop protection strategies focusing on Integrated Pest Management (IPM)
· Timely harvesting of crops after physiological maturity
· Use of proper storage structures to minimize losses due to pests and diseases
· Post harvest processing and handling to add value and demand for produce
· Marketing and selling products at the most profitable time.

The traditional and low yielding crop production practices in Ethiopia must give way to modern and high yielding approaches if the ever-increasing population size is going to be fed adequately.

The institutions and policies must be devloped and reformed to make this possible.

The portrait of famine in the Ethiopian context is indeed complex; I have no illusion that the perspective I am going to give, food crop production for combating famine, is going to be the only major solution to the famine problem, although it has to be a significant component of the package of solutions. There are several other critical issues such as the ever-increasing population size, climate change accompanied by frequent droughts,

abject poverty and the associated lack of purchasing power of the population, the accelerated degradation of natural resources, land tenure /use/ administration that does not encourage productivity and investment on the land, inadequate infrastructures and markets, lack of alternative employment opportunities, and so on. I have been asked to give a perspective on the crop production component as it relates to famine. This is what I will try to do.

At the outset, I would like to say that the grand challenge for Ethiopia is restoring and improving the environment and the natural resource base for crop production that has been abused and misused for centuries; making it more productive in a sustainable manner.

Feeding the ever-growing Ethiopian population with the continuously shrinking and nutrient depleted soils is going to be very difficult to say the least. The realistic option under the current Ethiopian scenario is to increase the food productivity per unit of land. The science and the technological options available to realize higher productivity than what the Ethiopian farmer gets are widely available both locally and internationally.

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With the assumption that all of the non-crop production issues bearing on solving the famine problem in Ethiopia are addressed adequately, my perspective will focus on the technological options to curtail famine and malnutrition in the country.

In most parts of Ethiopia, people rely on food crops production for their livelihoods. Most produce their own food. Subsistence agriculture is the norm in much of the country. To get access to food crops, people either produce food on their own land or purchase food if they have the purchasing power.

Under situations where farm households rely on their own food production, the production method and system used by the typical farmer are traditional and rainfed and

have not changed for centuries. In particular, in areas where rainfall is short and drought is common, crop production is unreliable and entire communities are often chronically exposed to food insecurity and frequently to famine. Crop production under these circumstances, using traditional practices, has not curtailed the onslaught of famine on the population.

The traditional and low yielding crop production practices in Ethiopia must give way to modern and high yielding approaches if the ever-increasing population size is going to be fed adequately. What are the components of such a modern and high yield productive system? I will mention and examine below a dozen of the major components.

1. **Improved Seed**: This is central to any production system. The best quality seed of the best available cultivars suitable for the agricultural zone under consideration is the nucleus of a successful and productive system. This may be a hybrid or open pollinated seed.

2. **Fertilizer Use**: Application of the right kind and amount of fertilizer is a must for realizing high crop yield. This must be promoted aggressively. Chemical fertilizers are the most practical, although animal manure and green manuring may be used as supplements when and wherever possible. For Ethiopian soils, in general, N and P are necessary.

3. **Water**: Whether water is obtained as rain or supplied in the form of irrigation, it is often the primary determinant of obtaining a good or poor harvest.

4. **Farm Power and Implements**: The proper farm power and implements are essential for land preparation, cultivation, weeding, harvesting, and threshing

5. **Land Management**: Optimum land and seedbed preparation are necessary for good

stand establishment, a necessary prerequisite for a good yield.

6. Cultural Practices: Proper planting date/rate/depth and row planting are important components of a good crop management program.

7. Weed Control: Timely weed control is a mandatory component of a good crop production program.

8. Crop Protection: Integrated Pest Management (IPM) is the crop protection strategy of choice. Chemicals should be used only as a last resort.

9. Harvesting: Timing is important, delay of harvesting after physiological maturity can entail losses due to pests and diseases.

10. Storage: Use of proper structures and low moisture content can minimize loss due to insects, diseases and rodents.

11. Marketing: The farmers should strive to sell their products when they can get the best price.

12. Value Added Products: Post harvest processing and handling can raise the value and demand for the farmer's produce.

1. Seed Industry

A viable and aggressively functional seed industry is the engine that drives the transformation from traditional agriculture to technology based modern agriculture. All other inputs and improved production practices rely on good seed for their effectiveness. Wherever possible and applicable, hybrid seeds provide the proper incentive and avenue for building a thriving national seed industry which in turn drives the engine of improved and accelerated crop production. The proper production and distribution of good quality

seed is a catalyst and stimulus for a well functioning /productive national research and extension system.

The introduction of hybrid seeds into the production system has triggered the emergence and establishment of good and successful seed industries and eventually increased crop production in other countries such as India, Kenya, and Zimbabwe. In all these cases, hybrid maize was the key to the success of the seed industry. In the case of India, hybrid sorghum played an important role also. All other crops followed subsequently. Learning from the successful experiences of the countries mentioned above it is highly advantageous to the country to promote and encourage the growth of private seed companies.

Concerted efforts are needed to establish a vigorous and vibrant seed industry. As an example, in nurturing the seed industry in India, in the mid 1960s, the Rockefeller Foundation placed three seed industry specialists among 14 staff of breeders, agronomists, crop production specialists (Lee House, n.d.). In Kenya and Zimbabwe, large scale farmers were the prime movers of the seed industry establishment and growth.

Ethiopia needs a seed industry that is properly linked to the research and extension system as well as the end users of the seed, the farmers, to contribute significantly to fighting famine and hunger in the country in a sustainable manner.

2. Fertilizer Use

If increased food production to feed the ever-increasing Ethiopian population is to be achieved, there is very little practical and economical alternative to the use of mineral fertilizers, particularly N and P sources of fertilizers. The proper use of mineral fertilizers not only enhances crop yield but can play a significant role in reducing land degradation and soil nutrient depletion.

Mineral fertilizers consumption on food crops in Africa in general is said to be the lowest in the world (Quinones et al, 1997). Some argue that we should rely more on the use of organic fertilizer such as animal manure but unfortunately there is not enough quantity of it at all places, even if it is available it is too bulky to transport to where it is needed the most. The traditional use of dried dung as fuel is a major deterrent to using animal manure as a significant and country-wide means of improving soil fertility. Wherever animal manure is used as a traditional component of the farming system, such as in the enset culture areas, this practice should obviously continue. Farmers should be encouraged to use as much animal manure as possible in all farming systems but this use can often be as supplement to mineral fertilizers. Since the mid 1990s, the importation and use of mineral fertilizers (N and P) in Ethiopia has shown progressively increasing trend which should be encouraged to continue (SG 2000, 2002).

3. Water

In most situations in Ethiopia, shortage of moisture is the first limiting factor in crop production. Ethiopian food crop production is primarily dependent on rainfall. During years of favorable rainfall, harvests are adequate but when the rains are inadequate there is very little to harvest. Hence it is important to conserve water and use it efficiently for crop production.

The overall water resources available in Ethiopia are generally good. What is required is to properly conserve and utilize the water as and when it is needed. Consequently, the more extensive use of irrigation in the Ethiopian food production system is essential if the chronic food insecurity and repeated famines experienced in much of the country is to be curtailed.

Several and alternative water conservation measures need to be employed as appropriate for each locality.

- Water harvesting through several techniques and the critical need for supplementary irrigation

- Building ponds
- Building micro-dams
- More extensive use of streams and river waters
- Underground water and bore hole
- *In situ* water conservation such as using the soil as moisture bank, improving infiltration through proper tillage, tied ridges, minimizing run-off, reducing erosion, minimize soil and water loss. Without increased use of irrigation, huge opportunity for crop production is lost most of the year.

Improving water conservation and harvesting and improving the water use efficiency and water delivery systems are central to solving the food production problems of Ethiopia.

4. Farm Power and Implements

The farm power and implements used in Ethiopia are ages old. Often the power used on Ethiopian farms comes from the use of oxen and human labor. The implements used are also unimproved and have not changed for centuries. All these have to change if improved and raised agricultural productivity are to be realized on a meaningful and significant scale.

Much larger proportion of the Ethiopian farm lands must come under tractor power and more modern machinery, than is the case now. This means more land consolidation to enable the proper economies of scale of land is essential.

In the case of implements, starting from the traditional plow all the way to harvesting and storage tools, they are generally inefficient and entail drudgery. Research centers, both at the Ethiopian Agricultural Research Organization (EARO) and the regional levels, have a number of improved prototypes of tools and implements which have been tested and found promising, such as the improved versions of the traditional plow, planters with fertilizer attachments, improved bee hives, improved grain storage structures etc. These prototypes need to be taken up by private investors, multiplied, and widely distributed to

farmers if the typical Ethiopian farmer is to be more productive and also reduce the drudgery of farming in Ethiopia.

5. Land Management and Tillage

Proper and science based land management is a prerequisite for increasing production and productivity at the household level. Soil and water conservation and management at the farm level contributes directly to natural resource management at the catchments and watershed levels. If the proper land management practices and physical structures and biological conservation measures are in place at the farm and the catchments level, water can be conserved *in situ* and be immediately available for crop use, soil erosion will be minimized, crop and animal productivity will be increased. Under high slope and hillside situations, the physical construction of bunds and terraces are necessary, on the other hand, on flatter lands it may be necessary to construct drainage structures. When physical structures such as rock bunds are made, it is essential to supplement them with trees, shrubs, grasses, and legumes, so that the soil and water conservation measures will be more permanent. In the recent past, massive efforts have been underway in the country, particularly in the north, to construct rock bunds and terraces but more biological conservation supplements are yet to be done. Since all land is not suitable for crop production, unsuitable classes of land should be left alone and closed. Under such situations, flora and fauna will flourish and soil and water resources will be conserved for the benefit of the overall environment and overall sustainability of production.

In good land management and tillage efforts, the use of tied ridges, gully rehabilitation, minimizing soil and water loss, and conservation /minimum tillage are important.

6. Cultural Practices

The proper cultural practices appropriate for each ecological zone determine to a large extent whether a farmer's harvest is going to be good or bad. In additioin to proper land and water management, cultural practices and overall good crop management have a

crucial role in determining crop yield. Such practices as planting on the right date, using the right seed rate and attaining the optimum plant population, planting in rows, establishing a good stand, timely weed control, use of crop rotation, cropping pattern (such as sole cropping, mixed cropping, relay cropping, strip cropping), timely harvesting, threshing, transporting to stores, and proper storage are all critical components of a successful crop production practice. Some of these components are well known and traditionally recognized by farmers, others need research and extension support and advice, for farmers to use them properly and effectively.

7. Weed Control

Weeds constitute a major group of enemies of crops, if weeds are not controlled on time they rob crops essential resources of water and nutrients. Newly introduced weeds such as *Parthenium* have become very aggressive and are spreading at an alarming rate. More established and traditional weeds such as the parasitic weeds *Striga* and *Orobanche* have infested some fields so severely that such fields are often abandoned or the farmers are forced to grow a less desirable alternative crop. When available, resistant varieties are the best means of controlling parasitic weeds.

8. Crop Protection

After crops are planted, in addition to weeds, they are attacked by a wide range of enemies collectively known as arthropod pests, diseases, birds and other vertebrate pests. The severity of damage from a specific pest or pest group varies by location, season, crop type and farming system. Insect pests such as stem borers could wipe out the entire crop of sorghum and maize, non-crop specific pests such as locusts and army worms could devour entire fields in hours and days. Plant diseases are ever-present worries of farmers, some notorious and prominent examples are rusts of wheat, late blight of potato, maize streak virus of maize.

Birds, particularly *Quelea*, are enemy number one of sorghum and other cereals. Sorghums with good grain quality and early maturity could not be grown in most localities particularly in the drier parts of the Rift Valley, where it is the most suitable crop, because of the *Quelea* menace.

Farmers have to take multi-pronged approaches to control pests, diseases, and weeds. Often the integrated pest management (IPM) strategy employing a combination of tactics, including genetic, biologic, cultural, and chemical (as a last resort) are cost effective, friendly to the environment, and often keep pests under the economic threshold level. Genetic resistance is a critical component in the use of IPM across crops and farming systems.

9. Harvesting

Proper and timely harvesting is critical for realizing high yield of high quality. After physiological maturity, the crop should be harvested as soon as possible. If harvesting is delayed, the chances for quality deterioration, especially if rains are present, are high. Diseases such as grain molds and sprouting of grains in the field could make them unacceptable in the market place or become unusable at all.

10. Storage

After harvesting and threshing the crop, storing it in the proper structure and condition until it is used or marketed is essential. Storage structures should be suitable for the producer's unique situation and environment. Pests and moisture are often the main issues of concern when crops are stored, hence the necessary precautions and arrangements must be made to minimize damages due to these factors.

11. Marketing

Without the proper and favorable marketing structure, high yields and bumper harvests in themselves are not sufficient incentives for the farmer to sustain high productive levels. Attractive markets leading to high profits and more money in the pocket of the farmer is the magic that will maintain the nation wide crop productivity at high enough level so that improved crop production could have a lasting effect on combating famine in the country.

12. Value Added Products

When there is a bumper harvest, as was the case with maize, a couple of years back, or more often in potato production zones, the market value of raw agricultural products sinks to the bottom so far down that even production costs may not be recovered. One of the ways of overcoming such problems is to focus on converting the raw products into value added products that can be stored longer and transported farther to get higher prices for the producer. Some examples are corn flakes, tortilla chips, oil, and potato chips etc. Sustainable higher and bumper yields should give rise to the establishment of more and more agriculture based small-scale industries.

Crops for Various Agro-ecological Zones

A wide range of food crops are grown under a wide range of ecological conditions in Ethiopia, ranging from hot lowlands all the way up to the frost affected highlands. Crops grown under these wide ranges of conditions are various kinds of cereals, pulses, oil crops, and horticultural crops. Many of the traditional crops in these groups are indigenous to Ethiopia and posses highly valuable wealth of genetic diversity, prominent of which are teff, sorghum, finger millet, barley, wheat, chickpea, lentil, noug, sofflower, and enset.

These crops are often grown under subsistence farms under rainfed conditions and are used as staple foods. Although the genetic diversity of these crops is high the yields

under farmers' conditions are very low. Science based crop production strategies are badly needed to improve productivity per hectare of these and other indigenous crops.

Crop yields in many parts of the world have increased tremendously within the last half-century except in sub-Saharan Africa, including Ethiopia. In sub-Saharan Africa, particularly in Ethiopia, the rate of increase in food production has been significantly below the rate of population increase. Therefore, the choice of the appropriate crops for each major ecological zone and the concomitant improvement of crop yields are necessary for producing more food.

The SG 2000 Experience in Ethiopia

The Sasakawa Global 2000 (SG 2000) program started its activities in Ethiopia in 1993 with the main aim of increasing agricultural food production at the level of small-scale farmers and stimulating the linkage between research and extension. SG 2000 initially used the Extension Management Training Plot (EMTP) on relatively large plots, often half hectare on-farm demonstration plots (SG 2000, 2002).

The SG 2000 EMTP plots strategy contained the following main components:

- Improved seed with the appropriate seed dressing and improved agronomic practices
- Recommended seeding rate, proper planting dates and methods, optimum stand establishment
- Timely weed control
- Recommended fertilizer use – including type, rate, time, and method of application
- Proper crop protection practices
- Credit for the purchase of inputs
- Training – for development agents (DAs) and farmers
- Close follow up of the EMTPs by DAs

The crops used in the EMTPs have been mostly cereals, maize, wheat, teff, and sorghum. In the case of maize, the cultivars used were mostly high yielding and tested hybrids obtained from the national research system. The yields of the EMTPs have in general been two to three times the yields obtained from traditionally managed plots (Table 1).

Table 1. Mean yields, in qt/ha, for the period 1993 – 2001.

	Experiment Station**	**EMTPs***	**Traditional***
Maize	100	50	15
Wheat	60	30	10
Teff	30	16	6

Source: * SG 2000, 2002; ** Various EARO reports

Both fertilizer consumption and the sale of hybrid maize seed have increased dramatically since the early 1990s, for fertilizers ranging from a little over 100,000 tons in 1994 to just under 300,000 tons in 2000 and the hybrid maize seed sale ranged from slightly over 300 quintals in 1995 to just over 57,000 quintals in 2000.

The Ethiopian government has adopted the EMTP strategy and designed the National Extension Intervention Program (NEIP) patterned after the SG 2000 experience, which numbered about 3.6 million demonstration farms in 2001.

Among the problems which surfaced through the implementation of the NEIP are:

- Marketing and processing to value added products
- Price collapse during years of good rainfall
- Shortage of improved varieties of high value crops as well as crops suitable for moisture-stress areas

Crop Yield Potentials

The potential of most of the important cereals (maize, sorghum, wheat) of the country as measured from experiment station yields is about double that of the yields obtained in the EMTPs. For example, the experiment station yield of selected high yielding maize hybrids can be as high as 120 qt/ha (Tesfaye Zegeye et al, 2001). This means there is much greater potential in getting higher yields than what has been realized through the EMTPs. The high yield potentials of sorghum and wheat can be as high as 80 qt/ha.
Crops such as potatoes have experiment station yields of about 400 qt/ha but the national average yield is about one seventh this potential (Dr. Haile Michael K.M, personal communication). Such high yields can be realized under farmers' production conditions if the proper inputs and management practices are employed.

With the application of science and the utilization of modern production methods, the yields of crops in Ethiopia can be increased several fold. The advent of the Green Revolution technologies in Asia and the Americas has made these regions self-sufficient in food production, almost eliminated famine, created excess production for reserve storage and export, and improved the quality of life for millions of people. The Green Revolution based crop production strategies have demonstrated that crop yields in many situations can be easily doubled or tripled; India and China are good examples of success stories.

Crop Diversification

Dependence and concentration on only a few crops has a number of negative consequences including price collapse during years of bumper harvest, build up of pests and diseases, declining soil fertility and so on. In as much as possible, in a given farming system, it is important to diversify crops across cereals, legumes, and oil crops. Since legumes and oil crops generally have lower yields they normally are not crops of choice in many farming systems. The proper combination of rotation or mixed cropping system could be more advantageous to the whole economy instead of depending on a few crops such as maize, wheat, and teff. For example, soybean, which is both a plant protein

source and oil crop, fits well in a rotation system where maize is a dominant crop. Successful experiences in other countries such as China, Brazil, and the USA show that this is a crop which does well in maize-based cropping systems. The national research system needs to give soybean research more attention and promote it in the appropriate situations. In ecological zones where sorghum is dominant, pulses such as haricot beans and cowpeas fit very well in the cropping system. In highland ecologies, where barley is the dominant cereal, faba beans fit well in the rotation system. Promotion of crop diversification needs a concerted effort of both the research and the technology transfer system.

Focus on the Technology Generation and Transfer System

High yields and bumper harvests at the national level are not sustainable in the long run if they do not continue to be supported by a vigorous and well-supported national research and extension system. The demonstrated successes in production through the SG 2000 EMTPs and the NEIP are results of decades of research through the national system. Once varieties of crops are released and distributed to farmers, it does not mean that it is the end of the game. High yielding varieties and hybrids invariably succumb to new or changed biotypes of pests and diseases. When such cultivars become susceptible and are forced out of the production system, the research system must be ready with suitable replacements. This is literally a never-ending race between plant breeders and changing forms of pests and diseases. Plant breeders have to stay ahead of the race all the time. The extension system must also be ready all the time to move to farmers with new cultivars and management advices. This means that the research and extension system must be in constant contact with each other to share information both ways and respond to the needs of the farming community without delay. All these require a continuing strong national support to both the research and the extension system. Unfortunately, linkage between research and extension, both at the federal and the regional levels, has not been strong. Despite repeated efforts over the last three decades, the situation does not seem to have changed much. This has to change for the better, if both research and extension are going to be more effective as is expected of them.

Conclusions

The traditional and low yielding crop production practices in Ethiopia must give way to modern and high yielding approaches if the ever-increasing population size is going to be fed adequately.

Ethiopia needs a seed industry that is properly linked to the research and extension system as well as the end users of the seed, the farmers, to contribute significantly to fighting famine and hunger in the country in a sustainable manner.

If increased food production to feed the ever-increasing Ethiopian population is to be achieved there is very little practical and economical alternative to the use of mineral fertilizers, particularly N and P sources.

Improving water conservation and harvesting, improving the water use efficiency, and water delivery systems are central to solving the food production problems of Ethiopia.

Farmers have to take multi-pronged approaches to control pests, diseases, and weeds. Often the integrated pest management (IPM) strategy employing a combination of tactics, including genetic, biologic, cultural, and chemical (as a last resort) are cost effective, friendly to the environment, and often keep pests under the economic threshold level.

The encouraging and demonstrated successes in production through the SG 2000 EMTPs and the NEIP are results of decades of research through the national system and are worth extending further.

Dependence and concentration on only a few crops has a number of negative consequences such as price collapse during years of bumper harvest, build up of pests

and diseases, and declining soil fertility. In as much as possible, in a given farming system, it is important to diversify crops across cereals, legumes, and oil crops.

High yields and bumper harvests at the national level are not sustainable in the long run if they do not continue to be supported by a vigorous and well-supported national research and extension system.

References

1. House, L.R. n.d. Seed Production and Distribution Experiences and Relevant Background Information. Bakersville, N.C.

2. Quinones, M.A., N.E. Borlaug, and C.R. Doswell. 1997. A fertilizer based green revolution for Africa. PP. 82-95. *In*: Replenishing Soil Fertility in Africa. R.V. Bursh et al (eds.). SSSA Publication 51. SSSA, Madison, WI, USA.

3. Sasakawa Global 2000, August 2002. Activities and Outputs: An Assessment 1993-2001.

4. Tesfaye Zegeye, Bedassa Tadesse, and Shiferaw Tesfaye. 2001. Adoption of high yielding maize technologies in maize growing regions of Ethiopia. Ethiopian Agricultural Research Organization (EARO). Research Report No. 41. 51 pp.