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Agricultural Practices that promote food security in Kenya

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ABSTRACT

Good agricultural practices (GAP) are Practices that address environmental, economic and social sustainability for on-farm processes and result in safe and quality food and non-food agricultural products. In simple language, GAP stands on four pillars (economic viability, environmental sustainability, social acceptability and food safety and quality). In recent years, the concept of GAP has evolved to address the concerns of different stakeholders about food production and security, food safety and quality, and the environmental sustainability of agriculture. These stakeholders include governments, food retailing industries, farmers and consumers who seek to meet specific objectives of food safety, food production, production efficiency, livelihood and environmental benefits. Adoption of a sustainable practice means that the farmer has accepted the idea as good and that he intends to include it in the ongoing program of land preparation, planting, and harvesting. In other words, adoption is the implementation and continued use of an agriculture practice. This is an important difference from trial or experimentation, because a farmer might try a sustainable practice and abandon that practice. Adoption of sustainable practices by farmers is the key to transforming agriculture into a long-term, sustainable system. How far sustainability can be achieved in a democracy depends greatly on farmers' voluntary acceptance of sound land use practices. Individual decisions are shaped by the availability of technical information and the appropriate machinery, seeds, and other inputs necessary to implement sustainable agricultural practices. This paper reviews literature on the good agricultural practices that promote sustainable food security.

Introduction

Food security is a condition related to the ongoing availability of food. Food security indicators and measures are derived from country level household income and expenditure surveys to estimate per capita caloric availability. In general the objective of food security indicators and measures is to capture some or all of the main components of food security in terms of food availability, access and utilization or adequacy. While availability (production and supply) and utilization/adequacy (nutritional status/anthropometric measures) seemed much easier to estimate, thus more popular, access (ability to acquire sufficient quantity and quality) remain largely elusive. The factors influencing household food access are often context specific. Thus the financial and technical demands of collecting and analyzing data on all aspects of household's experience of food access and the development of valid and clear measures remain a huge challenge.

Conventional agricultural practices, while capable of producing large amounts of food and fiber, frequently result in environmental degradation and socioeconomic losses. These negative aspects of conventional agriculture have led many to promote sustainable agricultural practices. Sustainable practices seek to ensure the future of agriculture by promoting environmental stewardship, generating an acceptable level of income, and maintaining stable farm families and communities (SARE, 2002).

The transformation of agriculture into a more sustainable system requires that farmers adopt sustainable practices. However, the factors that determine whether a farmer will adopt a sustainable practice are unclear.

In 2012, food insecurity is still a major global concern as 1 billion people are suffering from starvation, under-, and malnutrition, and the Food and Agriculture Organization of the United Nations (FAO) has concluded that we are still far from reaching millennium development goal (MDG) number 1: to halve extreme poverty and hunger by 2015. In sub-Saharan Africa, the number of people suffering from hunger is estimated at 239 million, and this figure could increase in the near future.

There are many examples of food insecurity in sub-Saharan Africa, some of them having reached catastrophic dimensions, for example, in the Horn of Africa or southern Madagascar. Food insecurity is not just about insufficient food production, availability, and intake, it is also about the poor quality or nutritional value of the food. The detrimental situation of women and children is particularly serious, as well as the situation among female teenagers, who receive less food than their male counterparts in the same households.

Soaring food prices and food riots are among the many symptoms of the prevailing food crisis and insecurity. Climate change and weather vagaries, present and forecast, are generally compounding food insecurity and drastically changing farming activities, as diagnosed by the Consultative

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Group on International Agricultural Research (CGIAR) in June 2011.

The key cause of food insecurity is inadequate food production. Since the global food crisis of 2007–2008, there has been an increasing awareness throughout the world that we must produce more and better food; and we should not be derailed from this goal, despite some relief brought by the good cereal harvests in 2011–2012. This is particularly true in sub-Saharan Africa, which needs and wants to make its own green revolution.

The African challenge indeed is key to mitigating food insecurity in the world. Commitments were made by the heads of states and governments of the African Union to double the part of their domestic budgets devoted to agriculture in 2010–2011, so as to reach 10%. Technical solutions exist and there are indeed, throughout Africa, good examples of higher-yielding and sustainable agriculture. But good practices have to spread throughout the continent, while at the same time social and economic measures, as well as political will, are indispensable ingredients of Africa's green revolution. It is also necessary that international donors fulfil their commitment to help African farmers and rural communities and protect them against unfair trade, competition, and dumping of cheap agrifood products from overseas

The notion of a more sustainable agriculture, one that could transform conventional systems and assure agricultural production into the future without long-term negative impacts, has its roots in criticisms of conventional agriculture. King F.H (1911) reported in his analysis of farming in the 19th century that the traditional agricultural systems in China, Japan, and Korea were far more efficient and productive, and resulted in less negative environmental impacts, than American agriculture by recycling biological wastes and using less off-farm inputs. The Dust Bowl of the early 1930s demonstrated that yield increases provided by conventional tillage practices result in long-term negative effects on soil degradation (Soil and Water Conservation Society, 1995). In the middle of the twentieth century, controversial books such as Edward Faulkner's The Plowman's Folly (1943) and Rachel Carson's Silent Spring (1962) revealed the environmental destruction resulting from conventional agricultural practices.

The social upheaval of the 1960s and 70s, as well as the agricultural recession in the early 1980s, exposed the societal and economic pitfalls of conventional agriculture. The 1990s brought consolidation and increased power of agribusiness companies, a continued loss of farms, increased competition from other agricultural producing countries and a continued reduction in commodity prices, as well as increased dependence on government subsidies. As more and more farmers, professionals, and the public became aware of the problems resulting from modern agriculture, a movement towards more sustainable agricultural systems emerged (McIsaac, 1994; Klinkenbourg, 1995). In recent decades, sustainable farmers and researchers around the world have responded to the extractive industrial model with ecology-based approaches, variously called natural, organic, low-input, alternative, regenerative, holistic, biodynamic, bio-intensive, and biological farming systems. Yet sustainable agriculture remains the broader paradigm for combining social, economic, and environmental soundness with a concern for future generations. Defining sustainable agriculture has been a difficult task for farmers and agricultural professionals alike. Sustainable agriculture has been defined as "a system in which resources are kept in balance with their use through conservation, recycling, and/or renewal, practices preserve agricultural resources and prevent environmental damage to the farm and off-site land, water, and air, production, profits, and incentives remain at acceptable levels, the system works in concert with socioeconomic realities" (Journal of Sustainable Agriculture, 2000). A definition incorporated in the 1990 Farm Bill in the USA, states, "the term sustainable agriculture means an integrated system of plant and animal production practices having a site-specific application that will, over the long term: (a) satisfy human food and fiber needs; (b) enhance environmental quality and the natural resource base upon which the agricultural economy depends; (c) make the most efficient use of non-renewable sources and on-farm resources and integrate, where appropriate, natural biological sources and controls; (d) sustain the economic viability of farm operations; and (e) enhance the quality of life for farmers and society as a whole." While a universally agreed upon definition of sustainable agriculture has yet to emerge, it is clear that sustainable agriculture must be an economically, environmentally, and socially balanced farming system that preserves the viability of resources for future generations (Diver, 1996; Norman et al., 1997; Bell, 2001). These three facets of sustainable agriculture shall be our working definition throughout this document.

Sustainable Agricultural Practices

Despite being touted as a solution to conventional agriculture's problems for the past 40 years, sustainable agriculture did not achieve widespread attention in the United States until the late 1980s and early 1990s (the USDA did not establish an official sustainable agriculture program until 1988). The slow emergence of sustainable agriculture as a viable alternative to conventional production before this time was largely a result of resistance and negative perceptions held by many in the agricultural community, as well as lack of education, research, and government programs supporting and promoting sustainable agricultural practices (Norman et al., 1997).

By the 1990s, however, research had provided enough evidence to suggest that sustainable agriculture practices were capable of transitioning conventional agriculture into an environmentally sound system while maintaining productivity and global competitiveness (Harsch, 1991). These researches, along with successful implementation of sustainable techniques by a handful of innovative farmers, demonstrated that sustainable agriculture was indeed a valid agricultural system. Sustainable practices began to be taken seriously, and by the mid-1990s had begun to be featured in many mainstream farming publications (Klinkenbourg, 1995).

In order for this transition to take place, farmers must adopt tillage and land care approaches that protect and regenerate soil and water resources. Trends in adoption of sustainable agriculture worldwide indicate that sustainable practices are utilized on only a fraction of the world's farming operations. In a global survey, Pretty and Hine (2001) report that sustainable agriculture is presently utilized on only 3 percent of the total farmland in Africa, Asia, and Latin America. In the United States, only a select few sustainable practices have been widely adopted. However, whether these practices are truly sustainable remains a question. Many farmers who practice conservation tillage, for example, still rely on heavy use of conventional chemicals to control weeds and pests.

This information suggests that despite the many potential benefits of sustainable agriculture, the vast majority of farmers continue to depend on conventional techniques.

Adoption of a sustainable practice means that the farmer has accepted the idea as good and that he intends to include it in the ongoing program of land preparation, planting, and harvesting (Beal and Bohlen, 1965:3). In other words, adoption is the implementation and continued use of an agriculture practice. This is an important difference from trial or experimentation, because a farmer might try a sustainable practice and abandon that practice. Adoption of sustainable practices by farmers is the key to transforming American agriculture into a long-term, sustainable system. As Roberts (1995:44) articulates, “How far sustainability can be achieved in a democracy depends greatly on landholders’ voluntary acceptance of sound land use practices.” Individual decisions are shaped by the availability of technical information and the appropriate machinery, seeds, and other inputs necessary to implement sustainable approaches. The market and infrastructure perspective on innovation diffusion suggests that the supply of materials and technical ingredients is a basic predisposition to adopt sustainable practices (Brown, 1981).

Shaping the demand for sustainable practices is the social support of peers and family members. It is also clear that sustainable agriculture practices reflect an orientation and personal commitment manifested in a farming style that protects and preserves land and water in ways that conventional approaches have tended to overlook. A sustainable farming style reflects a constellation of practices and choices that fit the enterprises, soils, and terrain of an individual farm. Adoption can also have a cascading effect when an individual farmer adopts a sustainable practice. Arellanes and Lee (2003) show that farmers who had adopted one sustainable practice were six times more likely to adopt additional sustainable practices. Additionally, farmers adopting sustainable practices can influence other farmers around them to consider adoption as well (Barrett et al., 2002).

Compatibility with Current Practice

One of the issues most clearly voiced by farmers is the need for any practice they adopt to be compatible with their current systems of production (Drost et al., 1996). Compatibility in an agricultural sense means that any sustainable practice adopted must be adaptable to the geographical area and climate, the farmer’s resources and capabilities, and the specifics of the farm itself (for example, weeds, soil type, terrain, erosion potential, and other site specific factors) (Cutforth et al., 2001).

Farmers have been shown to be unwilling to adopt sustainable practices that do not fit well with current production strategies (Nowak, 1991); farmers have a set of practices with which they are comfortable. A farmer has normally reached this system of practice through trial and error over a period of years, and knows better than anyone what works on his or her farm. An individual farmer’s system is not easily changed; thus, any sustainable practice must be compatible before adoption can take place (Drost et al., 1996). Farmers have reported that compatibility barriers include increased labor requirements, inability to utilize current equipment, environmental practices that reduce flexibility, lack of time, climactic and farm specifics, and specificities of commodities or markets (Nowak, 1991; Norman et al., 1997; Souza Filho, 1997; Arellannes and Lee, 2003). In contrast, a farmer wants productive and efficient practices that do not require excessive labor or personal time and that adapt to market and weather changes (Roberts, 1995).

Land Tenure Shapes Decisions

While not as frequently mentioned in adoption literature, the issue of land tenure, namely that of owning versus renting land, can be an important determinant of whether a farmer adopts or does not adopt sustainable practices. Although land tenure issues contain aspects of education, economics, and personal characteristics, because of the unique aspects of land tenure and its relationship to adoption we have chosen to treat it as a separate category. As small farms continue to fail and larger farms take their place, conventional farmers are increasingly relying upon rented land to farm enough acreage to remain profitable. Farmers now rent more land than they own, often in many fragmented parcels. This is because in the conventional agricultural economy, small acreages are rarely profitable, forcing farmers to farm more land to increase production (Horne and McDermott, 2001). The result is that many farmers are also tenants, and thus do not have complete control of the land they farm. This often has a negative effect on the willingness of the farmer to adopt sustainable practices.

An important factor in the decision to adopt sustainable practices is not farm size, but rather farm ownership. For instance, Ikerd et al. (1997) reported that the sustainable producers they surveyed farmed less than half the number of acres, but realized higher farm incomes, than their conventional counterparts. However, although sustainable farms are smaller in general, farmers own a greater percentage of the land they farm (Northwest Area Foundation, 2004). Importantly, Arellanes and Lee (2003) discovered that farmers who owned their land were four times as likely to adopt sustainable practices.

Family, Friends, and Neighbors farmers interact with

Social factors, while overlapping societal factors in many ways, refer to the farmer’s community, family, and the people they meet in their respective geographic region who influence his or her decision to adopt a sustainable farming practice. The importance of social influences with regard to adoption of agricultural practices has long been known. Due to the social relationships that exist in farming communities, adoption by one farmer affects others’ decisions to adopt (Brown et al., 1976; Dillman, 1988). The adoption-diffusion model, for instance, demonstrates that adoption of an agricultural practice becomes more and more widespread once farmers see their fellow farmers successfully adopting that practice (Rogers, 1983).

Cancian (1979), after analyzing adoption of agricultural practices in farming communities, concluded that an individual farmer’s social situation highly determined his or her decision to adopt a new practice. Farmers from the upper middle class were the least likely to adopt new practices, for fear of losing their social status. Farmers from lower middle class and upper class were more likely to adopt because of benefit potential that it offered those in the lower classes, and those in higher classes could afford to take risks. Cancian concluded that a farmer’s social situation was at least as important, if not more so, than the farmer’s personal characteristics.

Social acceptability is a major issue with the adoption of sustainable practices. Social acceptability in this sense means that a farmer’s practices are viewed as acceptable by his or her family, friends, and local community. Fair weather and Campbell discovered (1996) that the level of social acceptability of organic farming played a role in a farmer’s decision to farm organically. Research has also indicated that negative stigmas about sustainable agriculture and the people who practice it still exist. Some communities still view sustainable practitioners or those considering sustainable practices as hippies who are out of touch with the realities of modern farming (Norman et al., 1997).

Worker Training

All produce handlers on your farm should understand the importance of proper health and hygiene and the role food safety plays in the quality of your product and the health of your customers. You can build this understanding, and score key audit points, by conducting annual training on proper health and hygiene practices with all staff. At the minimum, the training should cover: the importance of good hygiene and hand washing, proper hand washes technique, when to wash hands, first aid procedures, properly using the restroom facilities, illness/injury procedures, and your policy on taking breaks and eating. This can be in the form of formal presentations, videos, demonstrations, or one-on-one instruction.

Globalization brings new opportunities for food producers, along with new challenges to meet growing demands for quality and food safety. Capturing new opportunities to export high-value horticultural products will require producers to manage safety from farm to table and to meet increasingly stringent food-safety standards in import markets. Successful performance in export markets has the potential for substantial gains from trade, as well as generating income in the rural sector in the United Republic of Tanzania, but at the same time, it requires new and different kinds of market coordination. The public sector can play a role in improving food safety and quality to meet export-market standards, and addressing domestic issues of consumer safety at the same time.

Market liberalization and growth in international trade have created export opportunities within the horticultural sectors of many developing countries. At the same time, rapid urbanization and income growth in these countries have lead to increased consumption of horticultural produce, thereby expanding opportunities for small-scale producers, packing houses and other stakeholders in the horticultural sector. Tapping into these market opportunities is, however, dependent upon their ability to meet a plethora of stringent requirements. Produce destined for export must comply with the sanitary and phytosanitary (SPS) regulations of importing countries. It must also comply with private-sector standards and codes of practice, which have been put in place by importers and multiple chain supermarkets in order to respond to consumer requirements. Fresh produce sold in local format markets and in supermarkets must also satisfy consumer requirements for safety and quality. Coupled with these exigencies for produce safety and quality, are requirements for guaranteed supplies and consistent volumes of a variety of fresh produce items. Fresh produce can no longer, therefore, be taken to the market on the off chance that it will be purchased. Access to markets requires that produce be supplied through market driven systems in which market requirements known prior to production are used in specifying input quality as well as production practices and post-production handling.

Considerations on land history

It is necessary to identify possible sources of microbial and chemical contamination associated with the prior use of land that it is being used for agricultural production.

Such information for prior use of land can be obtained through interviews with prior owners, a review of municipal permits or village government and from other sources. As already stated, prior use of the land for animal feeding or domestic animal production and the presence of barns or farm animals a short distance from the cultivation site increase the risk of contamination of fruit and vegetables with pathogens commonly found in the intestinal tract of animals. It is also important to evaluate drainage systems and water currents flowing near these areas, which will help determine the potential for contamination. In some instances it may be necessary to create physical barriers or channels to divert water, which may carry contamination from the animals.

When the land has been used for garbage disposal or as a waste management site, it may contain decomposing organic matter and perhaps, faecal material. The soil may also contain harmful chemicals or toxic contaminants. Land that has been used for mining or petroleum extractions can be contaminated with heavy metals or hydrocarbons; it is recommended to carry out analysis of toxic substances in the soil. Asphyxia and colonized by different micro-organisms as well as soil erosion. Soil preparation should enable the root system to spread to a depth of 40 to 60 cm for shallow root crops to ensure good water and mineral supply to the plant (loose, fine soil). Any ploughing should be performed once a year and be completed before cropping by leveling and finer loosening, for example, by two runs of an offset plough set at a depth of 15 to 25 cm.

Soil

The physical and chemical structure, and biological activity, of soil are fundamental to sustaining agricultural productivity and determine, in their complexity, soil fertility. Soil management will maintain and improve soil fertility by minimizing losses of soil, nutrients, and agrochemicals through erosion, runoff and leaching into surface or ground water. Such losses represent inefficient and unsustainable management of these resources, in addition to their potential deleterious off-site effects. Management also seeks to enhance the biological activity of the soil and protect surrounding natural vegetation and wildlife. Good agricultural practice will manage farms in accordance with the properties, distribution, and potential uses of the soils, maintaining a record of the inputs and outputs of each land management unit. Maintain or improve soil organic matter through the use of soil-building crop rotations and appropriate mechanical and conservation tillage practices. Maintain soil cover to minimize erosion loss by wind and/or water. Apply agrochemicals and organic and inorganic fertilizers in amounts and timing and by methods appropriate to agronomic and environmental requirements.

Water

Agriculture carries a high responsibility for the management of water resources in quantitative and qualitative terms. Careful management of water resources and efficient use of water for rain fed crop and pasture production, for irrigation where applicable, and for livestock, are criteria for good agricultural practice. They include maximizing the infiltration of rain water on agricultural land and maintaining soil cover to avoid surface run-off and minimize leaching to water tables. The maintenance of adequate soil structure, including continuous macropores and soil organic matter, are important factors to achieve this. Efficient irrigation methods and technologies will minimize losses during the supply and distribution of irrigation water by adapting the quantity and timing to agronomic requirements to avoid excessive leaching and salinization.

Water tables should be managed to prevent excessive rise or fall. Good agricultural practice will Maximize water infiltration and minimize unproductive efflux of surface waters from watersheds. Manage ground and soil water by proper use, or avoidance of drainage where required, and by build-up of soil structure and soil organic matter. Apply production inputs, including waste or recycled products of organic, inorganic and synthetic nature by practices that avoid contamination of water resources. Adopt techniques to monitor crop and soil water status, accurately schedule irrigation, and prevent soil salinization by adopting water-saving measures and re-cycling where possible. Enhance the functioning of the water cycle by establishing permanent cover or maintaining or restoring wetlands as needed. Manage water tables to prevent excessive extraction or accumulation. Provide adequate, safe, clean watering points for livestock.

Crop and fodder production

Individual annual and perennial crops, their cultivars and varieties, are chosen to meet local consumer and market needs according to their suitability to the site and their role within the crop rotation for the management of soil fertility, pests and diseases, and their response to available inputs. Perennial crops are used to provide long-term production options and opportunities for intercropping. Annual crops are grown in sequences, including those with pasture, to maximize the biological benefits of interactions between species and to maintain productivity. Rangelands are managed to maintain plant cover, productivity, and species diversity. Harvesting of all crop and animal products removes their nutrient content from the site and must ultimately be replaced to maintain long-term productivity. Good agricultural practice will select cultivars and varieties on an understanding of their characteristics, including response to sowing or planting time, productivity, quality, market acceptability, disease and stress resistance, edaphic and climatic adaptability, and response to fertilizers and agrochemicals. Devise crop sequences to optimize use of labour and equipment and maximize the biological benefits of weed control by competition, mechanical, biological and herbicide options, provision of non-host crops to minimize disease and, where appropriate, inclusion of legumes to provide a biological source of nitrogen. Apply fertilizers, organic and inorganic, in a balanced fashion, with appropriate methods and equipment and at adequate intervals to replace nutrients extracted by harvest or lost during production. Maximize the benefits to soil and nutrient stability by re-cycling crop and other organic residues. Integrate livestock into crop rotations and utilize the nutrient cycling provided by grazing or housed livestock to benefit the fertility of the entire farm, Rotate livestock on pastures to allow for healthy re-growth of pasture and adhere to safety regulations and observe established safety standards for the operation of equipment and machinery for crop and fodder production.

Crop protection

Maintenance of crop health is essential for successful farming for both yield and quality of produce. This requires long-term strategies to manage risks by the use of disease- and pest-resistant crops[1], crop and pasture rotations, disease breaks for susceptible crops, and the minimal use of agrochemicals to control weeds, pests, and diseases following the principles of Integrated Pest Management. Any measure for crop protection, but particularly those involving substances that are harmful for humans or the environment, must only be carried out with full knowledge and appropriate equipment

Animal production

Livestock require adequate space, feed, and water for welfare and productivity. Records of livestock acquisitions and of breeding programmes will ensure traceability of type and origin. Stocking rates are adjusted and supplements provided as needed to livestock grazing pasture or rangeland. Chemical and biological contaminants in livestock feeds are avoided to maintain animal health and/or to prevent their entry into the food chain. Manure management minimizes nutrient losses and stimulates positive effects on the environment. Land requirements are evaluated to ensure sufficient land for feed production and waste disposal. Good agricultural practice will:

Animal health

Successful animal production requires attention to health of livestock which is maintained by proper management and housing, by preventive treatments such as vaccination, and by regular inspection, identification, and treatment of ailments, using veterinary advice as required.

Animal welfare

Farm animals are sentient beings and as such their welfare must be considered. Good animal welfare is recognized as freedom from hunger and thirst; freedom from discomfort; freedom from pain, injury or disease; freedom to express normal behaviour; and freedom from fear and distress.

Harvest and on-farm processing and storage

Product quality also depends upon implementation of acceptable protocols for harvesting, storage, and where appropriate, processing of farm products. Harvesting must conform to regulations relating to pre-harvest intervals for agrochemicals and withholding periods for veterinary medicines. Food produce should be stored under appropriate conditions of temperature and humidity in space designed and reserved for that purpose. Operations involving animals, such as shearing and slaughter, must adhere to animal health and welfare standards. Good agricultural practice will Harvest food products following relevant pre-harvest intervals and withholding periods, Provide for clean and safe handling for on-farm processing of products. For washing, use recommended detergents and clean water, Store food products under hygienic and appropriate environmental conditions. Pack food produce for transport from the farm in clean and appropriate containers. Use methods of pre-slaughter handling and slaughter that are humane and appropriate for each species, with attention to supervision, training of staff and proper maintenance of equipment. Maintain accurate records regarding harvest, storage and processing.

Conclusion

In conclusion Good practices must be identified and examples of successful agricultural development should be publicized. In other words, the agricultural models that will lead to sustainable development must be prioritized. The frequency and increased intensity of extreme climatic events, such as droughts and floods, have become additional challenges for global agriculture, which is already facing higher demand due to both population increase and new consumption habits of several developing countries. In order to respond to this challenge, the selection of drought-resistant crops is part of the solution.In December 2010, Bernard Bachelier of the Fondation pour l'agriculture et la ruralité dans le monde (FARM) published a study on the prospects of genetic improvement of crops tolerant to drought. But this is not easy: the control of genes coding for water stress and extreme temperatures is very difficult; it is much more complex to develop these kinds of plants than pesticide-resistant crop varieties. Research in this area is in its initial stages and it targets crops with high economic potential, such as maize, and to a lesser extent, rice, sorghum, or millet, which play a smaller role in global trade, but which are nevertheless essential for feeding the populations of several developing countries.Bu t improved seeds are just one element of crop systems. Farmers confronted with weather vagaries or climate change should be assisted in the improvement of irrigation systems that enable crops to improve their resistance to drought

Farms require fuel to drive machinery for cultural operations, for processing, and for transport. The objective is to perform operations in a timely fashion, reduce the drudgery of human labour, improve efficiency, diversify energy sources, and reduce energy use. Farming produces by-products, some of which are potential pollutants of soil, water, or air. The production of these by-products should be minimized while others are resources that can be recycled. Good agricultural practice will establish input-output plans for farm energy, nutrients, and agrochemicals to ensure efficient use and safe disposal. Adopt energy saving practices in building design, machinery size, maintenance, and use. Investigate alternative energy sources to fossil fuels (wind, solar, biofuels) and adopt them where feasible. Recycle organic wastes and inorganic materials, where possible. Minimize non-usable wastes and dispose of them responsibly. Store fertilizers and agrochemicals securely and in accordance with legislation, establish emergency action procedures to minimize the risk of pollution from accidents. Maintain accurate records of energy use, storage, and disposal.

Farming must be economically viable to be sustainable. The social and economic welfare of farmers, farm workers, and their local communities depends upon it. Health and safety are also important concerns for those involved in farming operations. Due care and diligence is required at all times. Good agricultural practice will direct all farming practices to achieve an optimum balance between economic, environmental, and social goals. Provide adequate household income and food security Adhere to safe work procedures with acceptable working hours and allowance for rest periods. Instruct workers in the safe and efficient use of tools and machinery. Pay reasonable wages and not exploit workers, especially women and children. Purchase inputs and other services from local merchants if possible.

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