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Sustainable Food Systems and Agricultural Heritage Systems

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Abstract

This review explores the critical role of sustainable food systems and agricultural heritage systems in addressing global challenges related to food security, environmental sustainability, and socio-economic development. It highlights the limitations of current industrial food systems, including resource depletion, biodiversity loss, and increasing food insecurity. The paper emphasizes the importance of smallholder and family farming systems, which contribute significantly to global food production while preserving ecological balance and cultural heritage. It further examines the concept of Globally Important Agricultural Heritage Systems (GIAHS) as dynamic, resilient systems that integrate traditional knowledge, biodiversity conservation, and sustainable resource management. The study underscores the relevance of agroecological approaches, food sovereignty, and policy support in enhancing sustainable agricultural practices. It concludes that strengthening traditional and heritage-based agricultural systems is essential for achieving long-term sustainability, improving livelihoods, and ensuring global food and nutrition security.

Key Words: Sustainable food systems, Agricultural heritage systems, Agroecology, Food security, Smallholder farming, Biodiversity conservation, Food sovereignty, GIAHS, Sustainable agriculture, Rural development

Sustainable Food systems in Mediterranean region and Sustainable Development

Food is essential to a healthy life and has important implication on social, economic and environmental dimensions of sustainable development. It forms also an important part of cultural identity of both producers and consumers. While the current food system offers consumers inexpensive food, the quality of the calorie-rich but nutritionally deficient processed food with increased environmental footprint brings questions on the long-term sustainability of the current trends in the production and consumption of food. The Food losses and food waste in production, processing, transport and consumption stages impacts both food security and nutrition and the sustainability of food systems.

According to FAO, nearly one-third of the food produced for human consumption – approximately 1.3 billion tonnes per year – is either lost or wasted globally. A more holistic approach to food systems sustainability is needed, focusing on the structures, systems and relationships underpinning all stages of food production, processing transportation and consumption along the food chain. The management processes, in which social, environmental and equity dimensions are considered and integrated in a wholistic approach. Integrated strategies to promote better environmental and societal health and greater human well-being can then be more easily put into plans for action. The system of food provision is a key consideration for supporting sustainability - social, economic and environmental - at local and regional levels [1].

Regrettably, the decline in investment in sustainable agricultural and rural development, specifically on traditional agriculture, smallholders and family farming, has further constrained rural populations' available opportunities and is an important factor in rural stagnation and increased migration from developing countries particularly highlands, drylands, and in the fragile ecosystems where many of the rural poor live. Reducing world poverty is not only a moral imperative and a social good, but it is also a priority of global strategy for peace and stability and the survival of our planet.

For centuries the agricultures of developing countries were built upon the local resources of land, water, and other resources, as well as local plant and animal species and varieties and indigenous knowledge. This has nurtured biologically and genetically diverse smallholder farms with robustness and a built-in resilience that has helped them to adjust to rapidly changing climates, pests, and diseases.

The new models of food systems that humanity will need to in-

clude are the forms of farming that are more ecological, biodiverse, local, sustainable, and socially just. This means that they should be rooted in the ecological rationale of traditional small-scale agriculture, representing long established examples of successful community-based local agriculture. There should be closer connections between producers and consumers, therefore local production and consumption and increased link between rural and urban areas. In the face of such global trends, the concepts of food sovereignty and ecologically based production systems (e.g. Agroecology) have gained much attention in the last two decades.

Since the early 1980s, hundreds of agroecologically based projects that have been promoted by NGOs and farmer's organizations throughout the developing world, have shown that by blending elements of both traditional knowledge and modern agricultural science, the productivity and sustainability of small farming systems can be optimized and thus enhancing the conservation of natural resources and local and national food security. The emerging concept of food sovereignty and Agroecology emphasizes farmers' access to land, seeds, and water while focusing on local autonomy, local markets, local production-consumption cycles, energy and technological sovereignty, and farmer-to-farmer networks.

The Role of Small Holders and Family Farmers in a Sustainable Food System

Small-scale, family farming and more traditional forms of agriculture and food systems could significantly address many problems of sustainable agriculture today and in the future. Smallholder and family farmers have adapted their systems and adopted new practices to economic and environmental changes at scale. They continue to supply most basic food commodities at local, national and global levels [2]. Their small-scale farms offer an array of environmental, economic, social and cultural services, and remain a source of employment, nutritious food, cultural value and quality of. These systems have been managed with time-tested resilience, ingenious combinations of techniques and practices that have typically led to food sovereignty, sustained resources and incomes, and the conservation of natural resources and biodiversity. Indeed, agricultural systems with high levels of social and human assets are able to innovate and adapt to uncertainties. Family farmers make the majority of contribution to agricultural production worldwide and are thus acknowledged as the key leverage for ensuring future food security. At regional levels, the smallholders in fact provide up to 80 % of the food supply in Asia and sub-Saharan Africa; among them women have a key role since they account for 43 % of the agricultural labour force of developing countries, rising up to almost 50 % in Eastern and South eastern Asia and sub-Saharan Africa [3]. Their model of farming is based on means of organizing agricultural production mainly relying on family labour, including both women's and men's. In family farming and traditional agriculture, the central approach is the integration of the production activities with the local landscape in which the resources are complementary, integrated and sustainably valued. The indigenous knowledge and traditional techniques that smallholder farmers apply indeed derive from the deep knowledge of the context they interact with and are adapted to. Such knowledge, apart from being the backbone of diverse and environmentally sustainable production systems, makes farmers able to adapt to modifications in their environment and thus more resilient to the changes expected in light of climate change and other pressures. In spite of these strengths, though, smallholder farmers are threatened by unfair trade and market forces and competitive pressure from globalization and integration into common economic areas, insomuch that their fate is either to become self-subsistence marginal producers, or to grow into larger units to compete with large industrialized farms which is in contrast with the current global needs [4].

In 2014, the declaration of the International Year of Family Farming gave rise to a number of events that focused attention on these farmers as the foundation of agriculture, which represents 88% of the world's farms according to FAO, well ahead of firms and agro-businesses. Within this category, family farmers and smallholders with less than 2 hectares of land represent almost 85% of such farms and account for around 40% of the world's workforce. Consequently, and because of their understanding of the often marginal lands they use, they have considerable potential to provide food security and nutrition, job creation, the reduction of poverty and inequality, sustainable livelihood and territorial development, if they are supported by judicious public policies, sustainable investment and fair access to market [5,6].

Globally Important Agricultural Heritage Systems (GIAHS)

The GIAHS comprises of a small proportion of traditional agricultural systems dispersed over many countries and regions. These agricultural systems all reflect common traits of rich biodiversity, knowledge systems, cultural diversity and environmental resiliency. The persistence of these systems tells a fascinating story of the ability and ingenuity of humans to adjust and adapt to the vagaries of a changing physical and material environment from generation to generation [7]. The custodians of these systems represent an abiding commitment to conservation and respect for nature, agricultural patrimony and comprise a legacy of considerable importance, even though modern agriculture constantly threatens the sustainability of these people and their inheritance. Because many of these traditional agricultural systems represent a wealth and breadth of accumulated knowledge and experience in the management and use of resources, it is imperative that they be considered as nationally and globally significant resources that require protection and conservation while being allowed to evolve dynamically [8]. It is suggested that such ecological and cultural resources are of fundamental value to the future of humankind. However, GIAHS face great challenges in adapting to rapid environmental and socio-economic changes in the contexts of weak agricultural and environmental policies, climate variability and economic and cultural pressures. Globalization is exacerbating pressures on small-scale household farming systems by promoting monoculture specialization emphasizing exports.

The penetration of global commodity-driven markets into re-

mote areas often creates situations in which local producers in GIAHS, have to compete with agricultural production from intensive (and often subsidized) agriculture in other areas of the world. Among these pressures, inadequate policies inducing subsidized external inputs and lowering farm prices for staples and cash crops often directly transform the overall economic viability and biodiversity basis of traditional systems [9,10]. This limits the capabilities of local inhabitants to meet their food security needs and livelihood requirements.

Often the impacts of these forces include: adoption of unsustainable practices and erosion of traditional knowledge, overexploitation of resources and declining productivity and land degradation, and importation of exotic domesticated species, leading to severe genetic erosion, as well as social disintegration and cultural erosion of rural communities and populations. In sum this leads to a dwindling capacity of these land use-livelihoods systems to deliver and sustain global goods and local benefits.

The current rate of extinction of cultures, habitats, and human-created ecosystems threatens to destroy all hope of meeting this century's food security challenges. There is a pressing need to preserve and safeguard the unique characteristics of agricultural heritage systems. Unless these systems are protected, the GIAHS will meet the fate of most other rural systems, which have been dying all over the world in the wake of industrialization and modernization. Strategies to protect these systems have to be conceived within a global context.

There are many policies that directly and indirectly impact the evolution of farming systems. Their interactions are complex, and thus their individual impacts vary according to the socio-economic and biophysical realities at each GIAHS site. Macro policies are important drivers of change, and they often determine the threats and opportunities that the farmers of a given system face. Exchange rates, trade liberalization, interest rates, fiscal policies, prices stability, and structural adjustment policies can in fact determine the likeliness of a given farming system continuing to be perceived as viable.

Agricultural sector policies naturally play a crucial role in the viability of farming systems: the allocation of funds such as how much is spent on irrigation, the subsidies for small-scale farmers or given commodities, and the regional distribution of funds, agricultural domestic market liberalization, land tenure policies, credit policies, international agricultural trade, agricultural income taxation, research and training, subsector policies and programs, and the reduction of subsidies and public services to the sector. These policies induce changes in pressure on natural resources and changes in local incomes that constrain the viability of given systems or practices while possibly benefiting others.

Certainly, policies concerning the manufacturing and services sectors must also be mentioned because they affect the terms of trade between these sectors and agriculture. They are of primary importance, also, in determining the 'push-pull' factors that may induce, for example, an increasingly significant income gap between rural and urban areas, and a strong rural-urban outmigration, or excessive pressure on the natural resources base of an agricultural system.

One way or another, all these policies impact a farming system's environmental conditions, composition and level of production. They affect the economic viability of individual farms within given farming systems, on the incidence of poverty and the level of food insecurity in the area, and finally on the level of outmigration, or inward migration, characterizing the system.

Policy reforms observed in the developing world during the last 30 years were often dramatic. Most changes were to liberalize trade policies, deregulate domestic markets, privatize and decentralize, within the context of continuing structural adjustment programs. In many countries, macro-economic policy changes were more effective and proved to be stronger engines of change for agricultural systems than policies in the sector.

External trade and exchange rates have a greater influence on agricultural transformation than central rural and agricultural development policies. However, rural and agricultural sector policies remain highly important in determining the magnitude and direction of the changes induced by macro policies and, in many instances, for specific farming systems and depending on the macro reforms within the country, they may remain a major, if not the principle, driver of change.

To summarize, the major drivers of loss of biodiversity are land-use changes, crop improvement programs, over exploitation of the wild resources, overfishing, high food consumption and waste in some societies, trade liberalization and agricultural subsidies. The consequences of these losses disrupt the lifestyles of the poor who depend upon local ecosystems for their livelihoods, especially in terms of food security.

communities and stakeholders involved (obtained through means that ensure that all affected sub-groups are informed and agreed), and (c) be obtained in a manner that is culturally meaningful to the relevant communities.

Agricultural Heritage Systems and Food Security

Increasingly, the global community has recognized that while the last half-century has witnessed striking increases in global food production through intensive use of inputs, such practices are depleting natural resources and impair the ability of agroecosystems to sustain production into the future. In addition, current intensive systems of production and food distribution have not significantly reduced the number of chronically hungry people around the world. We have highlighted that it is both possible and highly advantageous to address future needs by transitioning to systems of food production that are based on an effective use of ecosystem services and in ways that are regenerative, minimizing negative impacts. Such ecological approaches to food production tend to be knowledge-intensive processes, requiring optimal management of nature's ecological functions and biodi-

versity to improve agricultural system performance, efficiency and farmers' livelihoods [3,11-13]. The stress is thus on knowledge and management skills – of farmers, advisers and researchers- as a major input. In addition to the core desired output of productivity from all agricultural systems, there is a growing recognition that farms and farming have central roles for human livelihoods in many other respects beyond singular commodity outputs. Farms and farmers are and should be capable of providing multiple goods and services, often beyond farm boundaries. For example, many agricultural zones serve as watersheds for urban areas providing clean water for users downstream. Many agricultural zones occur in biodiversity hotspots, and in centers of crop genetic diversity and there is a need for famers to be able to continue maintaining these genetic diversities for the present and future generations. Farming systems contribute substantially to the diet diversity of local populations if they are diversified. They may be the repositories for centuries of traditional knowledge and culture, handed down through families. Increasingly, it is recognized that farming practices contribute - positively or negatively - to adaptation to climate change and the mitigation of greenhouse gases and sequestering of carbon in soils.

By adopting multiple-use strategies, many local and indigenous resource users and farmers manage, in situ, a continuum of agricultural and natural systems, obtaining a variety of products as well as ecological benefits. Diversified systems, such as those based on inter-cropping and agro forestry, and crop/livestock or crop/fish combinations, and those that manage the "associated biodiversity" of soil biota, pest and disease modulating organisms and others, are proven to be more sustainable and have been the target of considerable research. The favourable attributes are related to the higher levels of "functional" biodiversity and effects on the stabilization of agro-ecosystem processes. The challenge is to manage the agro-ecosystem so as to maintain or enhance key ecological services such as nutrient cycling, biological pest regulation, and water and soil conservation. Many traditional and local systems and management practices have developed over years and generations to exploit such relationships between species and inter-linkages between biological processes of land resources.

The use of livestock, for example, is essential to recycle nutrients and maintain ecosystem resilience in the traditional extensive agro-pastoral systems developed over generations in the drylands of Africa, as well as in the modified intensive systems using stall fed animals in Java, Indonesia and other parts of Asia, where population pressures are high. Moreover, modern agro-ecological technologies that build on increased scientific knowledge of such synergies are recently proving to be more productive, especially in marginal lands, and when the biological structuring of the farm is improved and labor and local resources are efficiently used. They are being adopted in diverse environments and by certain groups of farmers where the socio-economic and political environment proves propitious, as exemplified by organic agriculture, for the production of environmentally friendly but often high value produce, especially for urban communities. The best example of spontaneous adoption on a much wider scale is that of the uptake of conservation tillage in many countries.

In overall output, the diversified farm produces more food, but this is achieved with lower negative impacts on the environment, as research shows that small-scale farmers generally take better care of natural resources. For example, they demonstrate superior skill at reducing soil erosion and conserving biodiversity.

Agricultural Heritage and Nutrition Security

The recognition of the value of nutritional and dietary diversity is becoming an important entry point for exploring the roles and place of traditional agriculture in sustainable food systems. The causes and consequences of the impoverishment in food diversity and simplification of diets span culture, health, agriculture, markets and environment and are complex to address. However agricultural biodiversity can play an important role in reducing nutritional problems. The combination of various crops and animals in traditional agro-ecosystems permits not only the more-efficient utilization of ecological niches, it also increases locally available nutrients for human diets or improves household income, allowing the purchase of alternative food items on the market.

Indigenous species are important to health besides having an important role in ecologically based production systems. In many crops, the difference between one variety and another can make the difference between micronutrient deficiency and micronutrient adequacy. Initiatives that are implementing an integrated approach to sustainable food system and improved nutrition have successfully built upon locally available biodiversity to revitalize local or regional food products and systems and have had a positive impact on communities' livelihoods and health.

In many countries, consumers are already willing to pay more for products that come from sustainable agricultural systems organically produced food and traditional landscapes because of health and environmental concerns. Product certification is one of the most commonly used instruments to identify and add value to such products and can provide a price premium for producers. The market for certified organic products has been growing by 20% a year since the early 1990s, a lot faster than the rest of the food industry both in developed and developing nations. Estimates of future growth range from 10% to 50% annually depending on the country. Certification is used not only for organic products, estimated at over 35 million hectares in 2008, but also for those obtained through the use of a wide range of practices that conserve soil resources, wild habitats, endangered species or forest land. The Rainforest Alliance runs a certification programme for coffee from shaded plantations that maintain forest cover and prevent soil erosion. The Salmon-Safe Agricultural Products programme in the USA awards a label to farmers who protect salmon habitat. Fairtrade labelling embraces a concept of sustainability that goes beyond natural and environmental values to include social equity in securing livelihoods and adequate income for producers, especially from small holders and family farmers in developing countries.

There is great potential to develop markets for underutilized or wild species, given the wide availability of crops, livestock and fish that have not been (fully) domesticated or commercially exploited. Such developments would support the conservation through use of a wider range of genetic resources while providing farmers with opportunities to diversify livelihood options and increase their incomes, which is particularly relevant in dealing with global changes. The development of new markets, however, needs to take into account possible modifications along the entire supply chain, including measures to ensure stable supply of planting or breeding stocks, to adapt processing technologies and to set quality standards.

Agricultural Heritage and Agroecology

Despite the evidence of the resiliency and productivity advantages of small-scale and traditional farming systems, many scientists and development specialists and organizations argue that the performance of subsistence agriculture is unsatisfactory, and that agrochemical and transgenic intensification of production is essential for the transition from subsistence to commercial production. Although such intensification approaches have met with much failure, research indicates that traditional crop and animal combinations can often be adapted to increase productivity. This is the case when ecological principles are used in the redesign of small farms, enhancing the habitat so that it promotes healthy plant growth, stresses pests, and encourages beneficial organisms while using labour and local resources more efficiently.

Several reviews have amply documented that small farmers can produce much of the needed food for rural and neighbouring urban communities in the midst of climate change and burgeoning energy costs. The evidence is conclusive: new agro-ecological approaches and technologies spearheaded by farmers, NGOs, and some local governments around the world are already making a sufficient contribution to food security at the household, national, and regional levels.

Whether the potential and spread of agro ecological innovations is realized depends on several factors and major changes in policies, institutions, and research and development approaches. Proposed agro-ecological strategies need to target the poor deliberately, and not only aim at increasing production and conserving natural resources. But they must also create employment and provide access to local inputs and local markets. Any serious attempt at developing sustainable agricultural technologies must bring to bear local knowledge and skills on the research process. Particular emphasis must be given to involving farmers directly in the formulation of the research agenda and on their active participation in the process of technological innovation and dissemination through farmers-to-farmers models that focus on sharing experiences, strengthening local research, and problem-solving capacities. The agro-ecological process requires participation and enhancement of the farmer's ecological literacy about their farms and resources, laying the foundation for empowerment and continuous innovation by rural communities.

Food systems and Food Sovereignty

The development of sustainable agriculture will require significant structural changes, in addition to technological innovation, farmer-to-farmer networks, and farmer-to-consumer solidarity. The required change is impossible without social movements that create political will among decision-makers to dismantle and transform the institutions and regulations that presently hold back sustainable agricultural development. A more radical transformation of agriculture is needed, one guided by the notion that ecological change in agriculture cannot be promoted without comparable changes in the social, political, cultural, and economic arenas that help determine agriculture.

In order to protect livelihoods, jobs, people's food security, and health as well as the environment, food production has to remain in the hands of small-scale and family farmers and cannot be left under the control of large agribusiness companies or supermarket chains. Only by changing the industrial agriculture model of large farms can the downward spiral of poverty, low wages, rural-urban migration, hunger, and environmental degradation be halted [14-55].

"Greening" the Green Revolution will not be sufficient to reduce hunger and poverty and conserve biodiversity. If the root causes of hunger, poverty, and inequity are not confronted head-on, tensions between socially equitable development and ecologically sound conservation are bound to accentuate. Organic farming systems that do not challenge the monoculture nature of plantations and rely on external inputs as well as foreign and expensive certification seals, or fair-trade systems destined only for agro-export, offer very little to small farmers that become dependent on external inputs and foreign and volatile markets. By keeping farmers dependent on an input substitution approach to organic agriculture, fine-tuning of input use does little to move farmers toward the productive redesign of agricultural ecosystems that would move them away from dependence on external inputs. Niche markets for the rich in the North exhibit the same problems of any agro-export scheme that does not prioritize food sovereignty, perpetuating dependence and hunger.

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