

A Review on Mineralization on Sustainable Dryland Agriculture

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ABSTRACT

Sustainable dryland agricultural production relies on efficient and integrated systems for resource management, including irrigation and dryland farming, with water and soil conservation and efficient utilization of nutrients. The global annual production of crop-based food exceeds 200 million tons, however, about half is produced from irrigated and flood-prone areas and about a quarter of total crop production is fed to livestock. Due to increased water requirements for irrigation and other purposes, the water stress will grow in the next decades. In some regions, climate change threatens food production and will trigger major shifts in both the water and the nutrient budgets. Therefore, it is important to assess the potential of adaptation options in order to mitigate impacts on food security.

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INTRODUCTION

The idea of sustainable agriculture entails the development of new, highly technologically and informationally advanced agricultural practices that utilize significantly less energy and inputs that are acquired on the market. Sustainability, then, is the effective use of resources to meet evolving human demands while preserving or improving the environment and protecting natural resources. However, due to farmers' declining ability to invest and their dwindling land holdings, this will not be as simple to achieve as stated. To accomplish sustainable growth, the nation's entire agricultural sector will need to be reoriented toward sustainability. The system needed to be designed with the long-term impacts on the environment in mind. It is crucial in the Indian context that we preserve the quality of our land, water, and environment in addition to meeting our agricultural goals. If agriculture serves to maintain the population, improves the quality of the environment and natural resources that it depends on, and creates meaningful jobs for the farming community, then it can be considered sustainable.

Gaur and Mukherjee (1980) investigated the impact of mulches on the population of microorganisms in the soil and discovered that mulching had a positive impact on the populations of actinomycetes, fungus, and bacteria. Joshi and Singh (1981) discovered that the conventional method of water harvesting for gathering runoff water was contour bunding. Although there are significant drawbacks to such a system, they are nevertheless outweighed by their benefits in terms of soil conservation. The ridge and furrow planting system evolved to alter it. Building a pond on uncultivated land to collect runoff water that is

recycled as needed is the alternative method of harvesting water. Hariss (1984) revealed that the traditional approach of growing cereals, pulses, and oilseeds separately has been contrasted with the biological and financial response to the suggested package of techniques. With the cost of recommended technology increasing to Rs. 467 to Rs. 482 per hectare, there was a 122 to 262 percent increase in the cost of production in cereals (which was 60 to 75 percent due to fertilizer application alone). As a result, during the kharif and Rabi seasons, the net return per rupee of additional investment was Rs. 1.20 to Rs. 1.75. The author also stated that some of the enhanced seeds were not better than local types and were not even appropriate for the local conditions, according to the farmers' brief.

Allens and Fenster (1986) examined the advancements made in stubble mulch technology, which were crucial in reducing wind erosion on the Great Plains. Because stubble mulch tillage improves water conservation, it also lowers water erosion and has raised yields. When compared to more intense tillage, the drop in organic matter levels is clearly evident. Malik et al. (1986) discovered that boosting soil profile moisture and limiting weed density are two key benefits of tillage during the dry season. After each shower, some mild soil cultivation should come next. Gupta (1990) examined that it is becoming more and more clear how important it is for natural scientists and farmers in India to work together. It is becoming increasingly obvious that a different kind of research is required to support farmers trying to service in high risk environments, even though natural scientists have focused on developing agricultural technologies best suited to ecologically uniform and research-rich regions

like the irrigated plains. Actually, the majority of national and international agricultural research institutions now acknowledge the importance of on-farm research, saying that it is essential to comprehend farmers' risk-adjustment techniques and to summarize the science that supports farmers' farming methods. Parr et al. (1990) examines the idea of sustainability and the requirements to increase the dryland agricultural system's production, stability, and sustainability, taking into account its opportunities, constraints, viewpoints, and tactics.

Singh et al. (1990) centered on methods for dryland farming in the USA and developing nations that are economic, productive, and ecologically friendly. Numerous facets of dryland farming, include biological diversity, economics, tillage, erosion control, management of residues, conservation of soil and water, and the integration of crops and cattle. Kooten and Van (1991) studied dryland agriculture and land degradation (including the loss of water-foul habitat) in Saskatchewan, Canada, in order to develop regulations for sustainable agriculture. There is development of insights into suitable institutions and strategies for attaining sustainable development in other sectors of agriculture.

Ninan et al. (1991) emphasized that developing nations like India were able to overcome long-term food shortages and large food exports thanks to the green revolution of the 1960s, and researchers are very interested in the nature of the impact, particularly in relation to growth, equity, and sustainability. With specific reference to dryland agriculture in India, this research offers a novel examination of the growth/instability debate. It also uses disaggregated data to confirm the overall validity of the growing costs of cultivation argument. The impact of watershed improvement programs on the economy and agriculture of India's arid regions is then evaluated. Apart from the issues of equity and food scarcity, the focus on dryland agriculture in addition to the green revolution can be explained by the prohibitive costs of future irrigation investments and the remote possibility of irrigation benefiting about 40% of India's arable lands, even if potentials are fully realized. The analysis covers the country as a whole as well as the South Indian state of Karnataka, which states that around two thirds of its land is at risk of drought with little to no rainfall. The information comes from the official records of the Karnataka and Indian governments, and it spans the years 1955–1956 to 1988–1989.

Swaminathan (1991) in contrast, chemical pesticides and large machinery have favorable economic effects but negative effects on ecology and equity. These findings from research on the sustainability impact of technology and policies indicate that mineral fertilizers have a beneficial influence on equity and the economy but a negative impact on the environment. Integrated pest management (IPM) and integrated nutrition supply, on the other hand, have favorable effects on all three fronts—

economic, ecological, and equitable. Young (1991) found that the interface between agriculture and the environment has received more attention as a result of growing awareness and concerns about the connections between agricultural policies, practices, and particular environmental problems—some of which have major long-term effects. As a result, it is now understood that agricultural policies and those aimed at preserving, improving, and safeguarding the environment need to be better integrated. It is anticipated that more sustainable agricultural systems will arise from the pursuit of integrated policies.

The degree to which macroagricultural policies consider their impacts on the environment and the degree to which environmental policies consider their implications on agricultural output, income, and pricing is known as the agriculture/environment integration issue. Integrated policies can support logical, effective, and sustainable development in both the economic and ecological senses by appropriately balancing the interests of both sectors. This book is a compilation of studies done for the ad hoc group on agriculture and the environment of the World Commission on Environment and Development (WECD). The studies were done in response to concerns about the direction of agricultural policy and the scope of environmental issues related to many agricultural practices. The paper presents the findings from the second part of the World Commission on Environment and Development's (WECD) study on the coordination of environmental and agricultural policies. Using a policy area approach, each section examines policy matters in a number of different nations with the goal of identifying overarching themes that are probably applicable to all WECD (World Commission on Environment and Development) nations. The case studies primarily focus on the following problems and issues: (i) the interface between intensive crop production and agricultural chemicals; (ii) the interface between intensive animal husbandry and animal manure; (iii) dryland agriculture and soil conservation and erosion; (iv) the interface between changing land use patterns and rural quality; and (v) the effect of pollution from external sources on agriculture. Gao and Hu (1993) concluded that expanding the area of arable land, improving the soil, introducing organic cultural techniques, integrating animal production with other forms of agriculture, and improving plant varieties are all significant factors in the development of dryland agriculture. Increased earnings and the application of more intensive techniques are required for the dryland agriculture sector in northern China to continue developing. New areas should be developed and farmland's latent capacity freed. More efforts must be made to promote regional development, and market mechanisms should be employed to promote the development of dryland areas.

Sustainably improving agricultural productivity

Shah and Shah (1993) have expressed concerns about India's uneven agricultural development and the focus on irrigation-oriented methods to achieve quicker growth. Development initiatives should focus more on making effective use of inputs, since this will guarantee sustainability while also boosting crop yield. This essay looks at a few key areas of Gujarat state's balanced agricultural development. The advancement of dryland agriculture is crucial to achieving future increases in farm output, even in the face of technological stagnation. Comparative analysis An analysis conducted in the 1980s on the yields, input consumption, and returns of Gujarat's rainfed and irrigated areas revealed that dryland farming not only accounts for a significant portion of the overall production, but also exhibits good productivity results.

The main issue facing dryland areas is growth instability. Both the rainfed and irrigated sectors now have a lot of unrealized potential that may be realized with improved extension assistance to promote the use of advised fertilizer and agronomic techniques. However, significant financial investments are required to implement all-encompassing soil and moisture conservation programs in order to increase the consistency of yields in rainfed agriculture. The short-term policy focus should be on (i) utilizing the current production potential, particularly in irrigated crops, and (ii) boosting resources for yield stabilizing technology for dryland crops, given the financial restrictions. Long-term, the focus might need to be on developing new possibilities, among which irrigation extension would be a major one. Fernandez (1994) stated that using native seed varieties is crucial for sustainable agriculture. An abundant supply of alternatives for sustainable agriculture is offered by indigenous systems. Cleveland et al. (1994) found that regulating selection and controlling genetic resources through farmer control is the most feasible and efficient approach to ensuring long-term stability. If additional study validates this theory, then the current folk varieties will be crucial to the advancement of sustainable agriculture.

Randhawa et al. (1994) Concerns about the demands that rainfed agriculture may face in the future in India are voiced and explored. The most logical approach to resource management has been acknowledged, and these include contributing to the neglect of fodder security, production instability, degradation of the natural resource base, economic competitiveness of the production system, disregard for the perspective of farmers, insufficient attention to farm women, absence of the farming system in research programs, and poor databases for watershed management. Discussions are held regarding land degradation, soil erosion, and sustainable agriculture production systems. Three categories were identified for the economic benefits of watershed development programs: (i) productive or ecological; (ii) productive or economic; and (iii) job opportunities. According to Swaminathan (1994), the loss of biodiversity restricts our options for the future. For this reason, it is critical to

support rural and tribal families' in situ conservation methods, which are crucial for the development of sustainable agriculture and natural resources.

Singh (1995) stated that variations in crop growing practices, weather, and time of year all have a significant impact on crop canopy alteration, which in turn aggravates new pest attacks and highlights current ones. Numerous conventional methods, including cultural, biological, and resistant cultivars, can be used to control pests. If farmers work together to implement integrated pest management, or IPM, in their respective areas of operation, productivity can be increased. When deciding the management techniques to use against a certain pest that fit the agroclimatic conditions, farmers' decisions are crucial. Singh and Singh (1995) explored the idea of sustainability as it relates to challenges of general development and agriculture. The topic of recovering drylands through sustainable development is brought up in relation to their desertification. The components needed for sustainable development—such as organic farming and low-input agriculture—are explored. Reduction of soil erosion, use of legumes and cover crops, successful introduction of agro-forestry systems, and effective use of organic wastes are the main elements of an environmentally sustainable agricultural system. There are many different policy concerns pertaining to sustainability that impact all facets of development. A new policy that aligns population pressures from humans and cattle with carrying capacity is proposed, with land usage determined by land capacity. Strong legal measures and the development of human resources can stop land management.

Saviozzi et al. (1997) revealed that pig slurry (PS), wheat straw (WS), and a combination of the two (WSPS) are important for preserving soil fertility and fostering soil sustainability. Basu (1999) concluded that polythene mulch enhances physiological processes in a synergistic manner and increases the effectiveness of portioning, resulting in a high degree of production. Long-term soil moisture conservation reduces the need for irrigation; mulch prevents salinity development by preventing surface evaporation; and groundnuts fend off sucking insect attacks throughout the early phases of crop growth. Singh et al. (1999) highlighted the historical perspectives of research on dryland agriculture in India, issues related to dryland farming, information on natural resources, climate and soils, salinity, soil fertility management, fertilizer use, options for managing degraded and marginal lands, post-harvest technology, watershed management, and the economics of dryland practices are covered in 34 papers.

ASSOCIATION INDEPENDENT VARIABLES OF RESPONDENTS

Sanoria and Singh (1979) found a good and significant correlation between researchers' education and their ability to communicate, as well as between their background in rural versus urban areas and how they produce

information. Ghose (1982) discovered that, as comparison to untrained farmers, trained farmers knew more about the technologies behind high-yielding paddy types. Kher (1986) concluded that each category of sugarcane growers' level of knowledge was positively and strongly correlated with their engagement in extension.

Mayani (1987) discovered that while small and marginal farmers had a negative and significant correlation with their level of knowledge, there was a positive and significant association between the extent of knowledge of all the categories of groundnut growers and their engagement in extension. Compared to older farmers alone, younger farmers have a greater level of expertise. Mundhawa and Patel (1987) discovered that the amount of land that farmers owned and their level of knowledge regarding rainfed wheat farming were significantly correlated. Rani et al. (1989) stated that training has a direct impact on agricultural scientists' scientific productivity as well as a greater overall indirect effect from experience on their output. Reddy (1989) revealed a substantial difference in the knowledge level of improved agricultural technology between trained and unskilled farmers, with the mean knowledge score of trained farmers being 26.61 and that of unskilled farmers being 20.87. Nimje et al. (1990) indicated that social engagement did not exhibit a significant relationship with the amount of knowledge of cotton growers regarding dryland cotton technology, but education did have a significant association and the area of land held had a negative association.

Bavalati and Sundraswamy (1991) found that the amount of land held and the expertise of dryland farmers were positively and significantly correlated with each other. Additionally, he came to the conclusion that dryland farmers' knowledge of dryland farming operations had little to do with schooling. Daivadeenam and Satyanarayana (1991) also discovered a strong correlation between the researcher's production and schooling. Similar results were documented by Ambastha and Singh (1980). Nandvana (1994) revealed that adopters' understanding of well-recharge and their involvement in social and extension activities were positively and significantly correlated. Additionally, he came to the conclusion that there was no connection between the age, education level, and amount of land owned by well recharge adopters and their level of understanding regarding water conservation techniques. Veeraiah et al. (1997) revealed that while education, socioeconomic status, farm size, cosmopolitanity, participation in the media, extension contact, and level of aspiration had positive and significant relationships with their level of knowledge about recommended critical skills in rainfed groundnut cultivation, age had a negative and significant relationship. Bhati (1999) revealed that farmers' awareness of advised mustard production technology was negatively and strongly correlated with their age. In situ moisture conservation, the use of organic manure, proximity to an

agricultural support system, age, and farm mechanization were found to have highly significant effects on operational management variables (Singh 1999). On the other hand, the level of fertilizer use, family labor, and pesticide use were found to have significant effects on farmers' awareness of sustainable dryland agriculture. Regarding the strategic management variables, the most significant influences were found in innovation proneness, risk preference, economic motivation, planning orientation, production and marketing orientation, and education. On the other hand, farmers' awareness was significantly influenced by media exposure and family education. Similar factors affected extension staff members' knowledge of sustainable dryland agriculture, including age, education, experience, training attendance, rural-urban origin, parental occupation, and media exposure. Singh (2002) stated that there was a significant shift in the needs profile of agricultural scientists and that the training program appeared to have helped them enhance some of their primary motivation and other behaviors.

RESOURCE USE PATTERN AND ITS IMPACT

Bhatia (1979) examined the shifting trends in input demand and resource availability. He disclosed that the utilization of novel inputs, such as irrigation and fertilizers, has significantly increased in comparison to conventional inputs. In addition, the percentage of conventional inputs decreased from 76.50% in 1950–1951 to 60% in 1973–1974. Edwards et al. (1990) have noted that although technology-based farming methods have raised agricultural abundance and production, the ensuing effects on the environment and the economy have not always been favorable. In certain parts of the world, severe soil erosion, water pollution, and desertification are all commonplace. decreased farm income under certain situations. They have made the case for the urgent need for studies and instruction on farming practices that might boost output and earnings without negatively affecting the environment. Conway and Barbier (1990) have claimed that the world's cereal production increased dramatically as a result of the green revolution during the 1960s and 1970s. However, the post-Green Revolution era is beset with serious issues. Less gain has accrued to farmers with small and marginal land holdings than to those with greater income. Production is now more vulnerable to shocks and pressures from the environment as a result of intensive monocropping.

Vijayaraghavan et al. (1990) concluded the lack of quality seeds, their unavailability at department stores, the requirement to buy unsold seeds, the delay in fertilizer availability, the use of bogus and low-quality pesticides, the absence of weedicides in the agriculture department, and the inability to obtain seeds promptly were found to be the main issues facing farmers in dryland areas. Vlek (1990) stated that numerous long-term experiments conducted in West Africa have demonstrated the sharp decline in soil productivity and highlighted the

significance of cultural practices like applying fertilizer, returning crop residues, using manure, and using lime in order to improve and maintain crop yields without causing long-term harm to the base of natural resources. Gupta and Singh (1991) concluded that throughout the last 20 years, India's agricultural input productivity index has decreased. The dearth of research on sustainable agriculture is one of the main factors behind this trend. They draw attention to the fact that a significant advancement in agricultural research will benefit both farmers and input companies in the future. Liu and Lu (1992) studied how the world's land resource base for sustainable agriculture development is being affected by changes in land usage and the issue of tropical deforestation. Many emerging nations have experienced considerable changes in land use due to globalization, particularly the conversion of forest area into agricultural land to supply the growing demand for food and fiber.

CONCLUSION

Farmers' knowledge of the environmental and technological aspects of sustainable dryland agriculture ranged from moderate to low. Extension staff members had a moderate to high level of awareness of the environmental and technological aspects of sustainable dryland agriculture. Farmers' perceptions of the social and economic aspects of sustainable dryland agriculture ranged from moderate to high. The majority of farmers believed that technological elements such as the use of organic manure, mechanical weed control, fertilizer top dressing, broadcasting, summer plowing, livestock, and plant population adjustment were socially acceptable, economically feasible, and sustainable.

Extension staff members have a moderate to high perception of the social and economic aspects of sustainable dryland agriculture. Most extension staff members believed that technological elements like zero tillage, crop rotation, mixed cropping, fertilizer broadcasting, use of organic manure, mechanical and cultural weed control, drought-resistant high-yielding varieties, summer plowing, livestock, and horticulture were socially and economically sustainable. Most farmers had largely employed their land for agricultural crops when it came to resource availability and utilization. They were not only unable to obtain quality seeds but also labor, fertilizer, agrochemicals, credit, and agricultural information on time. Insufficient and more expensive than the existing resources. They had to deal with high labor costs, a convoluted credit application process, exorbitant interest rates, and inaccurate agricultural information that did not fit their needs.

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