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Approaches and Features of Biologically Intensive Farming system

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ABSTRACT

In order to substantially reduce the negative impact of conventional petro-chemical farming and to address the issues of poverty, agri-production, environment conservation and food security, it is high time to adopt biologically intensive farming (BIF) system around the globe. It plays pivotal role in conserving natural resources and improves soil health and agri-production. This article addresses the importance, approaches and features of biologically intensive farming system.

INTRODUCTION

Oue planet- the Earth- has a tremendous wealth of plant species and water that can sustain human life besides other living beings. Human beings have been suffering from hunger, malnutrition, depletion of natural resources and other natural and man-made problems. We have narrowed down the biodiversity of plant species which were used as food crops and limited to rice, wheat and maize as major crops that provide 50 percent of the plant-based calories we eat, and occupy 40 percent of the world's arable land. It's no more secret that our global reliance on such a limited set of food crops has wide implications. While these crops have had an invaluable role in reducing world hunger, they alone cannot provide the full range of nutrients people need to flourish. For this, a far more diverse diet is required, one that many of the world's poorest people are unable to access. This degradation of agricultural diversity also has severe consequences on global biodiversity and the natural environment including soil health. In this context the Food and Agriculture Organization (FAO) of the United Nations has pointed out why it's time to turn to some of the other approximately 5,000 potential food crops estimated to exist around the world (FAO, 2024). These are collectively known as "neglected and underutilized species" (NUS) – plants, animals and fungi whose contributions to sustainable food systems are under-

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valued due to a general lack of awareness and information. The NUS are typically native to the environments in which they are grown. As such, they have adapted to local conditions, and require fewer external and economic inputs than conventional crops. Many NUS can also thrive in marginal areas, in arid soil or on land considered unsuitable for other purposes. This makes them an important part of climate-change adaptation strategies, and economically viable for small-holder producers. Moreover, many NUS are highly nutritious and rich in micronutrients and bioactive compounds. While the world at large has overlooked these species in research and policymaking, and ignored their vast potential contributions to sustainable agriculture, rural livelihoods and affordable and nutritious diets, the same is not true of the communities that know and use them. Because most plant NUS are grown at home, often in kitchen gardens, or harvested from forests, they are usually tended by rural women and indigenous peoples, both for household consumption and to sell at local markets. As NUS enter markets, whether local, national or international, they have the potential to create earnings for the communities who hold the keys to understanding how to cultivate, use and process these plants. It should ne noted that NUS crops cultivations are confined to traditional subsistence farming within a broader framework of the biologically intensive cropping with the use of intercropping, use of organic manure and pest management practices. However, this understanding is disappearing fast, so it is essential to ensure that this traditional knowledge on NUS is preserved and transferred to the next generations. Traditional foods are an intrinsic part of human knowledge and are embedded in our ceremonies and how we understand ourselves and our communities. This is particularly true for indigenous peoples, whose foodways rely heavily on NUS but are often under-valued in their wider societies. Protecting NUS enables peoples to become ambassadors of their cultures and identities. By cultivating these foods, indigenous and rural producers are able to share their valuable traditional foodways, and build their rural livelihoods.

Small-scale producers constitute another sector or category of the entrepreneurs who provide over 70 percent of the world's food needs. Often they are known as small farmers. In Nepal and India around 70 percent of these farm households belong to this category. Obviously in such developing countries of Asia and Africa promotion of biologically intensive farming system in a broader sense is utmost important. Indeed this is the key to address hunger, food insecurity, rural livelihoods, environment conservation and strengthening human capital simultaneously.

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Governments should support small farmers, small and medium agribusinesses and civil society to promote inclusive and efficient food production and marketing systems that better integrate smallholder farmers and small and medium agribusinesses into food value chains. This will improve their access to markets, generate decent employment opportunities, and make nutritious food available (FAO, 2024). In another word, investing in small-scale agriculture and local food systems is one of the most impactful ways of tackling malnutrition and food insecurity, bringing lasting benefits to national economies (IFAID, 2025). Obviously, our need today is to transform the existing food production, marketing and consumption systems. Various researches have clearly noted that the transformation of agrifood systems can only be achieved through the collective action of a broad range of public and private actors, each of whom brings distinctive interests, needs, resources, influence and capacities. These are the aspects that the inclusive and organic biologically intensive farming (BIF) systems address for achieving few sustainable development goals.

APPROACHES OF BIF SYSTEM

BIF system employs three approaches, viz. participatory, holistic and self-reliance building (Rajbhandari, 2004). A brief description about these approaches is presented below.

Participatory approach

A farm system is not just a collection or gathering of crops and animals to which one can apply an input and expect immediate results. It is a complex of soils, plants, animals, fishes, insects/micro-organisms, water, tools/technologies, workers, other inputs and environment having synergistic interactions among themselves. It is the farmer who attempts to understand this synergistic interaction; and based on personal preferences, experiences and aspirations, manipulates the available inputs and interaction to produce output. In order to sustainably and efficiently use the available resources and technologies, all the adult members of the farm households must participate in the decision-making processes in regard to acquiring/using inputs/technologies, production practices and trade/marketing. BIF system pays special attention to this issue and puts the real growers at the focal point of a given agro-ecosystem. It starts and ends with the growers and the integrated farming system in a given agro-eco system.

Bio-intensive farming system is implemented at local levels (ecosystem) with the active and direct participation of local growers/ entrepreneurs. Local growers are

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also engaged in conducting participatory research in their own field in the technical assistance of the Technicians coming from development agencies (GOs and I/NGOs). They are also engaged in participatory extension activities at local level. Participatory research and extension activities are conducted jointly by the farmers and research/extension workers utilizing the Model Demonstration Farm (MDF) managed by the concerned grower(s) in his/their land. The MDF is also used as farmer's field school (FFS) to facilitate farmer-to-farmer extension and communication as well as farmer's marketing school (FMS) to facilitate marketing of their produce. "Farmer Field Schools (FFS) are an extension approach built upon principles of adult education and experiential participatory learning processes (FAO 2013). FFS provide a forum for farmers to meet and discuss real issues and experiment together on possible solutions that they can implement themselves. A typical FFS involves practical hands-on oriented learning processes in which groups of farmers (20-30) with a common interest within a given micro-catchment get together on a regular basis (ranging between weekly to biweekly depending on the specific needs of the group) to study the "how and why" of a situation in a given context under the guidance of a facilitator. The approach is particularly adapted to field learning activities that require unpacking the underlying basic science to enhance the farmers' conceptual understanding of relations and interactions. The farmers under the guidance of a facilitator make regular field observations, relate their observations to the ecosystem and combine their local experience with 'new' information before making appropriate management decisions" (FAO, 2013).

Holistic system approach or experiential learning and knowledge generation

Bio-intensive farming system promotes learning and knowledge generation by the growers' own actions, observation, and sharing of experiences. The systems approach was first developed and applied in biology and is probably most associated with ecology. An agricultural farm is part of an ecosystem and consists of the location specific system of the rural area (ecosystem) and, various sub-systems (crop/livestock /fishery/agro-forestry) which are inter-related. This concept of a series of interacting sub-systems within broader systems provides the integrating framework within which individual units are studied. In other words, the hierarchical level is conceptualized as a system composed of a set of subsystems (crop/livestock /fishery/agro-forestry). By applying this concept and approach to agricultural production processes, a set of hierarchically related agricultural systems can be identified. A typical farm household system (farm

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system) is bound to larger, higher agricultural systems in many ways. It is influenced by them and can influence them. A farm's crop production activities for example determine its cropping system. A system may be composed of several cropping patterns and involve the production of several crops. All components required to produce a particular crop and their environmental relationships are part of a cropping system. Individual crop (crop 1, crop 2, crop N) within a crop sub-system comprises a lower level of subsystems; and these subsystems comprise eco-physiological systems. Similarly, livestock production is another major subsystem in the agro-ecosystem. Socio-economic aspect comprises a subsystem in the farm system. Thus farms or farm households are the goal-oriented complex systems. Farmers have many goals and usually seek to increase income, avoid risks, and increase long-term benefits of resources/inputs. Bio-intensive farming system addresses all of these and other issues with an overall goal of increasing food and income security of the farm households, simultaneously managing local resources/ technologies in a sustainable way, i.e. without any detrimental impact on environment and health (Rajbhandari, 2001).

BIF system is thus a holistic system approach. It is based on experiential learning and knowledge generation system. BIF system is about sustainable management of natural resources in a given agro-ecosystem with specific cultural and knowledge base. It is therefore a development approach as well. Effective learning occurs when development of a conceptual framework is inextricably linked with development of effective traditional practice. In this approach learning is a developmental spiral of theory-informed practice being tested in real situations. In the context of a group, BIF system incorporates an appreciation of group dynamics and stages in group development. It is based on the concept of experiential learning as a continuous process of "identifying" the context of a problematic/ poor life-situation, "making sense" of this and "taking action" to improve the situation of livelihood, production, marketing, etc. Consistent with this is a systemic approach to facilitating learning. Experiential learning or knowledge generation system is constructed as a purposeful flux between experiencing, finding-out, making sense (conceptualizing) and taking action. The extent to which the learners understand this process or concerned growers (in case of operating BIF model demonstration farm) determine their capability to consciously guide the process. BIF system prefers participatory knowledge generation system, concept development and planning and taking action to effectively influence the productive synergistic interaction among the dimensions

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of livelihoods. The methodology emphasizes participation and calls for open and active patterns of communication based on interdependent relationships (Rajbhandari, 2015).

Much less as a problem of total food availability than problem of who produces the food and who has the income to buy it. A high priority is therefore needed to enable the tens of millions of resource-poor farm families to increase their production and improve its stability. Most of the governments in developing countries have been following the normal 'transfer-of-technology' (TOT) model for agricultural research and development. It has built-in biases which favor resource-rich farmers whose conditions are more or less similar to those of governmental research stations. TOT approaches have been modified through on-farm trials and demonstrations but the basic model and approach have remained the same. A second emerging model is 'farmer-first-and-last' (FFL). In bio-intensive farming system concept and approach developed by Rajbhandari (2001), Model Demonstration Farm (MDF) is based on FFL approach. It should also be regarded as a model for Field Laboratory (FL) of sustainable agriculture and rural development. This starts and ends with the farm family and the farming system in a given agro-ecosystem. It begins with holistic and interdisciplinary appraisal of farm families' resources, needs and problems, and continues with on-farm farmer's action research and extension, in consultation with the scientists, experiment stations and laboratories in a consultancy.

Self-reliance building and collective empowerment

Economic globalization and dependence of LDCs like Nepal on exotic inputs like synthetic fertilizers, pesticides, and crop varieties has simultaneously put the small farmers at the risk of experiencing external techno-economic shocks. Bio-intensive farming system's approach is to minimize the potential of external economic and technological shocks and build the self-reliance of the growers in various agricultural inputs/ technologies and finance. It is based on the approach of collective empowerment and social mobilization.

FEATURES OF BIF SYSTEM

Characteristic features of BIF system within the framework of its principles are as follows (Rajbhandari, 2004):

- Empowerment of people's organizations

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- Conservation and utilization of biodiversity (plant, animal, microorganism, landscapes)
- Eco- and health-friendly production systems (biologically intensive mixed farming; intensive crop rotation/cropping; optimum organic recycling; use of bio- or organic-fertilizers and bio-pesticides; integration of crop/ livestock/ agro-forestry components)
- Equal access to natural productive resources (land, seed, water, forest) and public services (education/skill training, health service, information)
- Use of sustainable technologies (technologies that promote the use of: indigenous knowledge system (IKS), traditional technologies/practices, locally well adapted and average yielding varieties/seeds; local livestock breeds; etc.)

Empowerment of people's organizations

Enhancing people's organization's identities as social capital through empowerment of local farmers' or women's groups and advocating for the rights of farming communities and women on natural productive resources like land, plant genetic resources and seeds, water, forest is an important feature of the BIF system. It is a demand driven problem-solving approach directly related to the needs of the rural marginalized population groups including women and the landless and their socio-economic environment. This approach places the small landholders and women at the center of the innovation. It is a promising alternative to traditional methods and the intensive chemical farming, which is based on commercialization of food production resources and process, greed market economy, and which is in control of a few rich people, landlords or corporations. Bio-intensive farming system flourishes when the rights of farming communities to natural resources, work/employment, food, education, health, information and skill development are translated into reality. This approach intends to make the farming communities aware of the fact that food security is a human rights issue, which includes a number of other human rights. And these rights are inter-linked with various dimensions of food security. Empowerment of the people's organizations is a primary work for advocacy on food security issues from the perspective of human rights (Rajbhandari, 1999).

Conservation and utilization of biodiversity

The integrated animation and bio-intensive farming system approach envisages that in-situ conservation, authorized utilization, and free exchange of plant genetic resources (PGRs) among the farming communities and researchers comprise an

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essential component of sustainable livelihoods. It encourages cooperation between farming communities and researchers for proper identification, documentation, conservation and utilization of biological diversity for the benefit of local farming communities, in particular, and for human beings, in general. Documentation, conservation and utilization of biodiversity (plants, animals and soil microorganisms) and the farming communities' control over plant and animal genetic resources are critical for preventing further degradation of the productive resource base, economic opportunities, poverty and the food insecurity situations as well as to make the livelihood of the rural population sustainable both in terms of space and time.

Eco- and health-friendly production systems

"Due to lack of ecological regulation mechanisms, monocultures are heavily dependent on pesticides. In the past 50 years the use of pesticides has increased dramatically worldwide and now amounts to some 2,6 million tons of pesticides per year with an annual value in the global market of more than US$ 25 billion. In the US alone, 324 million kg of 600 different types of pesticides are used annually with indirect environmental (impacts on wildlife, pollinators, natural enemies, fisheries, water quality, etc.) and social costs (human poisoning and illnesses) reaching about $8 billion each year. On top of this, 540 species of arthropods have developed resistance against more than 1000 different types of pesticides, which have been rendered useless to control such pests chemically" (Altieri et al. 2012b). These facts and figures clearly indicate the need of promoting / up-scaling eco- and health- friendly comprehensive alternative production systems to address hunger, poverty and livelihoods of the small farmers and marginalized population groups in the tropics and sub-tropics.

"Solid waste management has become one of the vital issues to protect health and public safety. Preparation of organic manures like vermi-compost, Farm Yard Manure (FYM) etc. from various organic wastes (agricultural wastes) will save our environment from pollution as well as application of these manures in agricultural land prevent those lands from the harmful effect of chemical fertilizers. It has been found that the vermi-compost treated soil showed better result in comparison to that demonstrated by the chemical fertilizers in terms of soil physical and chemical properties as well as productivity of soil" (Karmakar, Brahmachari, and Gangopadhyay 2013).

The bio-intensive farming system is a biologically intensive mixed farming system, which relies on intensive engagement of farmers, organic recycling

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optimization through intensive crop rotations, integrated plant nutrient management (IPNM), integrated pest management (IPM). The IPNM favors a very limited use of synthetic fertilizers in the field crops to complement organic or bio-fertilizers and IPM is about the limited use of less hazardous pesticides/fungicides integrated with/without plant-based or biological agents in emergency cases. Neupane (2000) has pointed out that integrated pest management (IPM) is the only eco- and health-friendly option available today for the management of insect pests in agriculture. Integrated pest management (IPM) is one of the techno-environmental components within the conceptual framework of bio-intensive farming system. The bio-intensive farming system relies on appropriate spatial management of field crops, vegetable crops, fruits and fodder trees as well as livestock and poultry for rational and ecologically non-destructive utilization of lands in the hills and mountains. Furthermore, it increases the soil fertility, revitalizes the degraded soil, decreases environmental pollution and prevents health hazards to humans and livestock as well as reduces further degradation of the environment, which otherwise might lead to desertification of the globe. It is, therefore, not only eco-friendly but also friendly to human and animal health (Rajbhandari, 2015).

Equal access to natural productive resources and public service

Equitable access to natural productive resources like land, community pasture/forest, medicinal plants, water sources and community irrigation water, and equal respect to the diversity of farming community (ethnicity, gender, sex, religion) at the local level are the essential prerequisites for attaining food security and sustainable livelihood. The community forestry, community pasture, community irrigation system, community food banks (*Dharam Bhakari*), community herbal garden, community-based women's health resource center, community-based health clinic, community-based information and communication center, and community-based agriculture service center are some of the local infrastructures or social capital, which would prove to be a sustainable way of ensuring community members' equitable access to common resources and public services.

Agro-ecotourism can be an important alternative enterprise for small farmers. Such an enterprise typically involves charging fees for access to public or private property for wildlife-related recreational activities such as hiking, canoeing, camping, and photography, or from the sale of items associated with these activities such as maps, food, canoe rentals, etc.

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Sustainable technologies

The learning process in agro-ecological innovation is systematic and guided by situation specific curricula that follow natural cycles of the subject which could be crop, animal, natural resource, or a community problem that requires collective action. A typical module of the curriculum may follow a "seed to seed" or "egg to egg" approach where the concept starts with the planting of a crop, through the seasons and is completed when the following season's crop is planted (Gallagher, 2003). Key livelihood issues that affect the community are blended into the curriculum as special topics based on farmers' priorities. This responsiveness to farmers' needs is phenomenally fundamental in developing the farmers' confidence in determining their destiny (Okoth et al., 2002). The BIF system as a kind of sustainable agriculture focuses on the community in terms of resources (human resources, animal power, seed, manure/fertilizers, bio-pesticides, agricultural implements, and finance), perfect social marketing and extension of technical skills and information through the local farmers' scholars and leaders, both male and female employing farmer-to-farmer (F-t-F) extension approach. The importance of indigenous knowledge and traditional technology (IKTT) has called attention to the necessity of understanding and respecting the different "realities", ethno-cultural diversity and experiences of native people. The BIF system approach relies on the utilization of indigenous knowledge, realities, resources and experiences, which have a history of hundreds of thousands of years, and, on the modern agro-ecological principles and scientific techniques that offer the potential to conserve and regenerate resources. It is close to the beneficiaries and low in cost with minimum reliance on external expertise, capital, resources and equipment, which has been shown to result in the over–dependence of farming communities.

Technological aspects of BIF include promotion of organic recycling, inter- or mixed- cropping, crop diversification and scientific crop rotations to increase the cropping / rotational intensity as well as to minimize the incidences of diseases and pests. In addition, it emphasizes the promotion of agro-forestry, renewable energy like solar energy, bio-gas, and improved cooking stoves aimed at conserving the forest, reducing the work burden on women in regard to collection of fuel wood and cooking food at the cost of their health (2010, 2011). The by-product of biogas plant is applied in the crop field for improving the soil fertility and structure. Furthermore, the time saved by infrequent movement to the jungle or forest is utilized for extra–income generation for livelihood. This approach

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facilitates farmer-to-farmer (F-t-F) communication and extension. The farmer managed model demonstration farms (MDF); maintenance of seed purity and improvement of local crop varieties with high food values in the farms by the farmers themselves; seed storage at household level and farmer-to-farmer information, education, communication and extension are the essential components of this technology (Rajbhandari 2001; 2004).

The model demonstration farms (MDFs) are the nodal points, which serve to be the field laboratory (FL) of the farmers or "Farmer's Field School". It is a model of the farmer-first-and-last (FFL) concept. It is managed by the farmers and used for demonstration, dissemination or extension of technology to the members of the local farming communities in cooperation with the researchers, scientists, or extension workers.

These farms are also used for participatory action research. MDFs serve to bridge the gaps between participatory action research, extension and capacity building (training, field visit) of neighbor farmers for higher stable production and income. MDF is not a replica of the conventional “transfer of technology” (TOT) for development model. It is rather an alternative to that model and intends to bring the growers in the center (Rajbhandari, 2015).

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