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The Future of Smallholder Farming in India: Some Sustainability Considerations

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Abstract: The biodiverse, predominantly crop-livestock mixed-farming in India is key to ensuring resilience to climate change and sustainability of smallholder farming agroecologies. Farmers traditionally grow diverse crops as polyculture, and agriculture is mainly organic/biodynamic with spirituality in food systems deeply ingrained. Job-driven out-migration of rural youths, the family labor force, and globalization of contemporary food choices under corporate industrial agriculture both adversely affect sustainability of traditional farming landscapes and compromise the nutrition and health of rural farming communities. Besides documenting information on general agri-food system policy inputs, our paper presents the results of an exploratory study of four crucial community-level initiatives conducted in four distinct agroecological landscapes of India, aimed at bringing sustainability to traditional farming and food systems. The driving force for fundamental change in agri-food system, and in society, is the question of sustainability. The organic and local food movements are but specific phases of the larger, more fundamental sustainable agri-food movement. While it is very critical to increase farmer livelihood, it is even more important to increase overall rural economy. It was found that four important interventions viz. linking organic agriculture to community-supported agriculture (CSA) initiatives; linking small-holder farming to school meal (MDM) programmes; enhanced market access and value chain development for local agricultural produce; and creation of employment opportunities at community level for rural youths and reducing over-dependence of rural population on agriculture as source of income can make traditional farming more profitable and sustainable. The transition to more sustainable methods of farming by selling the farm produce "locally" helps both consumers and farmers alike and is considered a future strength of smallholder Indian agriculture.

Keywords: smallholder farming; sustainability; India

1. Introduction

Small agricultural holdings constitute the vast majority of farms in many developing countries. The studies based on the World Programme of Census of Agriculture (WCA) 2000 indicate that the Asia and Pacific region has the smallest size of holdings in the world. Against an average overall size of 5.5 ha for 114 Food and Agriculture Organization of the United Nations (FAO) member countries, for which the data were available with the FAO, the average size of holding in Asia is only about 1 ha [1].

In India, smallholder and marginal farmers with less than two hectares of land account for 86.2% of all farmers, but own just 47.3% of the arable land, according to provisional numbers from the 10th agriculture census 2015–2016. In comparison, the census revealed that semi-medium and medium

land holding farmers own between 2 and 10 hectares of land, account for 13.2% of all farmers, but own 43.6% of crop area [2].

Such a large number of smallholder and marginal farmers, close to 126 million, according to the survey, poses enormous challenges for the government's extension arms to reach them with relevant technologies and farm support schemes. Moreover, conventional modern farming, based on green revolution principles, has limited benefits in diverse smallholder Indian agroecologies. Furthermore, these 126 million farmers together own about 74.4 million hectares of land—or an average holding of just 0.6 hectares each—not enough to produce surpluses that can financially sustain their families. This explains the rising distress for farmers in Indian agriculture. It is, therefore, being argued that India has to live with its smallholder farms and devise ways and means to make smallholder farms economically viable for sustainable development.

Traditional farming is highly labor-intensive and it is the family labor that has been mainly involved in various agriculture and joint activities at the community level. Our recent case studies in predominantly traditional rainfed crop-livestock small-scale mixed-farming landscapes of the Uttarakhand hills [3] have indicated that lack of economic incentives is forcing the rural youth, the main labor force, to out-migrate to urban areas in search of off-farm employment. The rural youth, in recent years, finding the agriculture not worth the effort. Moreover, sustainability in farming is guided by three interconnected principles of being (i) economically viable for farmers; (ii) socially fair to communities; and (iii) environmentally-friendly. These are the pillars of healthy development that should be in place to sustain the growing population in years to come. Promoting traditional food crops has been suggested as a sustainable solution for local farming systems and nutritional security through public awareness, political will, and policy support. Traditional farming systems have been reported to provide models that promote biodiversity, thrive without agrochemicals, and sustain year-round yields [4]. The potential of traditional food crops as "future smart foods" has also been duly showcased in a recent study [5].

The global agriculture sector, including forestry and fisheries, currently provides over 1 billion jobs [6] and 3% of the global gross domestic product (GDP) [7]. In many developing countries, agriculture provides from 20% to more than 50% of national GDP [7]. There is a wide disparity between developed and developing countries with regards to the proportions of their work force that are involved in agriculture (e.g., 6% in the EU versus 56% in Africa) [8]. The majority of the world's poor live in rural areas and their incomes are predominantly based on agriculture. It should also be recognized that most smallholder farmers are primarily focused on producing sufficient food for their families, and, once subsistence has been achieved, on marketing any surplus production for cash income. In considering the full impact of agriculture on GDP it is necessary to recognize that the value of food directly consumed by farmers and their families is often not taken into account when evaluating agriculture's contribution to national GDP and overall economic output levels [9].

As per the Economic Survey 2017–2018, the agriculture sector employs more than 50 percent of the total workforce in India and contributes around 17–18 percent to the country's GDP. Further, the economic survey says that with growing rural to urban migration by men, there is "feminization of the agriculture sector", with an increasing number of women in multiple roles as cultivators, entrepreneurs, and laborers. Globally, there is empirical evidence that women have a decisive role in ensuring food security and preserving local agro-biodiversity. Further, the economic survey points out that many measures have been taken to ensure mainstreaming of women in the agriculture sector, including earmarking at least 30% of the budget allocation for women beneficiaries in all ongoing schemes/programmes and development activities; initiating women-centric activities to ensure the benefits of various beneficiary-oriented programs/schemes reach them; and focusing on women self-help groups (SHG) to connect them to micro-credit through capacity building activities and to provide information and ensuring their representation in different decision-making bodies.

Around two-thirds of India's population is in rural areas and a large proportion of this population lives in abject poverty. According to the "Household Survey on India's Citizen Environment and Consumer Economy" [10], of the bottom 20% of India's income quintile, 89% live in rural areas. There is an urgent need to improve the economic scenario in rural India to have a

sustainable and robust growth model for the country as a whole. For sustainability in farming and food systems, there is an urgent need for a strong political will focusing on rural India.

While it is very critical to increase farmer livelihood, it is even more important to increase overall rural economy. As the small-holder agriculture is not providing full-time employment, the livelihood security of rural youths could only be achieved through reducing the over-dependence of the rural population on agriculture as a source of income. A suitable push needs to be given to creating enhanced off-farm job opportunities at community level in rural areas. What is also very critical is to impart skills to the rural workforce appropriately to enable them to get absorbed in the agriculture and other non-farm employment at community level.

The driving force for fundamental change in agri-food system, and in society, is the question of sustainability: How do we meet the needs of the present without diminishing opportunities for the future? The organic and local food movements are but specific phases of the larger, more fundamental sustainable agri-food movement today [11].

From some recent case studies [3,12,13], we identified the following four marketing interventions as better initiatives towards infusing sustainability in to traditional farming systems across the country, together with a strong political will and policy support:

1. Promoting community-supported agriculture (CSA) initiatives;
2. Linking smallholder farming to the midday meal (MDM) school feeding programmes;
3. Enhancing market access and value chain development for local plant food resources;
4. Enhancing off-farm employment opportunities for rural youth at the community level.

As part of our study, we undertook feasibility studies of the four community-level interventions in four distinct agroecologies of India: (i) hill and mountain; (ii) hot arid desert; (iii) central plateau; and (iv) north-eastern region. Our hope is that these initiatives will help enhance the livelihood security of native farming communities and bring sustainability to farming and food systems. The transition to more sustainable agriculture practices is needed that supports our growing population and also serves as an economic development engine to create jobs and prosperity in the now impoverished and depopulating rural areas.

The enhanced job opportunities at community level is specifically addressed with regards to organic farming, agro-ecotourism, women-centric non-farm jobs through self-help groups (SHGs), and community agro-forestry/forestry management interventions. These interventions would engage rural youths fully in farming and related jobs. Restricting outmigration of rural youths is considered very vital for the sustainability of traditional small-holder Indian farming.

Sustainability of small-holder traditional farming has been a big challenge in all Indian agroecologies. There has been large-scale ignorance at all levels—farmers, researchers, and planner/policy-makers—making smallholder farms economically viable for sustainable development. We therefore need a system in place where we help small-holder farmers sell their farm produce locally within their community that benefits consumers and farmers alike. In the global food security literature, the development of a local food system that includes organic farms constitutes a key point. This system could enhance a community's health and long-term sustainability through developing local food systems. Formal expansion of organic farming in traditional farming agroecologies and linking organic farming to CSA initiatives, school meal (MDM) programmes, and value chain development for local organic produce are explored in this study to make the "local" food system a norm rather than a niche. All these marketing interventions in combination with enhanced jobs at community level are likely to bring sustainability and profitability to traditional farming. Local food movements have therefore been regarded as offering new economic benefits for small-holder farms, reductions in the environmental footprint of food, and closer relations between consumers and producers, while providing good nutrition to consumers.

It is hoped that the above-stated four community level interventions would result in bringing sustainability in small-holder Indian farming and food systems. Besides farmer livelihood, the proposed interventions are likely to increase overall rural economy. These research findings will thus showcase working models for consideration by planners and policymakers to be integrated into state policies for sustainability in agriculture and overall rural development.

The study sites are part of a United Nation Environment implanted GEF project "Mainstreaming agricultural biodiversity conservation and utilization in agricultural sector to ensure ecosystem services and reduce vulnerability in India" being executed jointly by the Alliance of Bioversity International and the International Centre for Tropical Agriculture (CIAT), and the Indian Council of Agricultural Research (ICAR). The information generated in this study is expected to add value to the overall outcomes of the above project.

2. Materials and Methods

An exploratory study was undertaken in four distinct agroecologies of India, viz. hill and mountain, hot arid desert, central plateau, and the north-eastern region, to identify better community-level initiatives for bringing sustainability to farming and food systems. The study sites included representative agroecologies of the entire Uttarakhand hills (north-western Himalaya); parts of rural Jodhpur in western Rajasthan (hot arid desert); parts of the tribal Umaria district in Madhya Pradesh (central plateau); and parts of Assam-Jorhat and Golaghat (north-eastern region) (Figure 1). A total of 20 focus group discussion (FGD) meetings, involving a total of about 500 farmer households (HHs) from the entire Uttarakhand hills, were earlier organized and the above-listed four distinct interlinked marketing interventions were identified [3]. The feasibility of these interventions was worked out in the present exploratory study in the other three unique traditional farming agroecologies of India in 2019. Two focus group discussion meetings each were organized in these remaining three agroecologies and a total of about 500 farmer HHs were involved in all these (6 nos.) participatory interaction meetings. Altogether the information was documented from about 1000 farmer HHs for the present study.

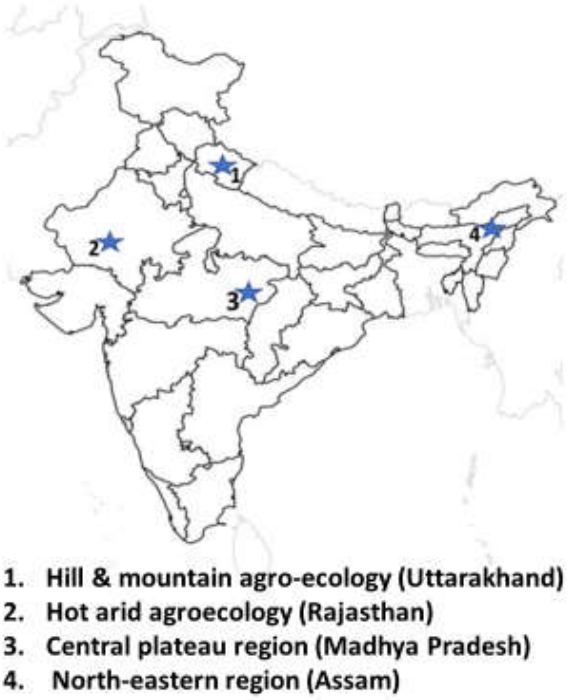

Figure 1. Study sites representing four distinct agroecologies of India.

A participatory approach was followed while interacting with the farmer HHs and due care was taken to include elderly and knowledgeable farm household representatives, including about 50% women farmers, as well as young adults, at each site. Due care was thus taken to include farmer HH representatives based on age, gender, education, wealth status, social status, ethnic group, etc.

Beside informal discussions, a structured questionnaire was also prepared to gain a general understanding and awareness of: (i) rural farming communities on agriculture, (ii) existing farming

practices, and (iii) sustainability issues. Table 1 lists some important policy input variables on general understanding and awareness of farmer HHs, relevant to small-holder Indian farming agroecologies.

Community-supported agriculture (CSA model) is a system that connects the producer and consumers within the food system more closely by allowing the consumer to subscribe to the harvest of a certain farm or group of farms. It is an alternative socioeconomic model of agriculture and food distribution that allows the producer and consumer to share the risks of farming. The model is a subcategory of civic agriculture that has an overarching goal of strengthening a sense of community through local markets.

It is hoped that CSA can be a better initiative in all smallholder farming agroecologies of India for "localized" livelihood support. When it comes to farm economy, the general experience seems to be that the income from CSA is moderate, but predictable, as the payments come in advance of the growing season [14,15]. Studies from the United States [16,17] and the United Kingdom [18] show that CSA farmers have better income than regular farmers. Additionally, the U.S. National CSA Survey of 2001 found that a majority of CSA farmers felt that the CSA was helping to "improve the ability to meet farm costs, their own compensation, their quality of life, their ability to maintain and improve soil quality and community involvement".

In general, arrangements of CSAs operate under the agroecological concept, which is regarded as having the potential to accommodate both changes in sustainable production and consumption (such as alternative food networks and CSA), and agroecological practice (at its best) can contribute to driving towards a sustainable food system. CSA was first developed in Japan and Switzerland in the 1970s. In the 1980s the idea became popular in the USA and also spread to several countries within Europe. Since the turn of the millennium, CSA has received particularly great attention and is experiencing considerable growth in many countries around the world. In 2008, URGENCI—The International Network of Community Supported Agriculture—was formed. URGENCI is the leading organization for networking and promotion of CSA worldwide.

For CSA initiatives and value chain development to local food resources, some informal discussions were also held with probable urban consumers near to the rural community sites of the present study on relevant producer-consumer variables.

The Midday Meal Scheme is a school meal programme of the Government of India designed to better the nutritional standing of school-age children nationwide. The programme supplies free lunches on working days for children in primary and upper primary classes in government, government-aided, local body, Education Guarantee Scheme, and alternate innovative education centres, *Madarsa* and *Maqtabs* supported under Sarva Shiksha Abhiyan, and National Child Labor Project schools run by the ministry of labor. Serving 120,000,000 children in over 1,265,000 schools and Education Guarantee Scheme centres, it is the largest of its kind in the world.

Linking agriculture with the Midday Meal (MDM) school meal programme is another important initiative to make traditional farming sustainable. According to the State of Food Security and Nutrition in the World, 2017, in India, over 190 million people are undernourished; that accounts for 14.5% of the country's population. Children are the worst affected; "The State of the World's Children 2016" Report by UNICEF ranked India 10th in terms of wasting and 17th in terms of stunting prevalence. While the UNICEF report considered children below the age of five, many school-aged children across the country are also battling hunger and malnutrition for reasons ranging from poverty to lack of sanitation. Many of them are forced to go to work, when they should be studying at school, thus missing out on education and getting caught even further in the vicious poverty cycle.

The Government of India can learn a lesson from the success of Brazilian National School Feeding Programme (PNAE). PNAE is Brazil's longest-standing public policy initiative for promoting food and nutrition security, providing meals not just to school children but indirectly to millions of local farmers. Started in 1954, the primary objective was to fight child hunger and malnutrition, and increase education levels. Over the years, the programme has expanded significantly, and now feeds 45 million children, as well as helping smallholder farmers to improve their economic status. How does it ensure the latter? In 2009, a law was passed making it compulsory for local governments to spend a minimum of 30 percent of their school meal budget on food commodities from smallholder

farmers. This step has helped schools to obtain fresh, more nutritious food from local fields and also opened up farmers to structured demand.

Brazil's integrated food and nutrition security policy approach promoted intersectorality in the food system, articulating actions to guarantee access to healthy food and to strengthen family farming. It was emphasized that local food production, school meals, and nutrition education can be linked through integrated programmes and policies, improving access to healthier foods, government leadership, strong legislation, civil society participation, and intersectoral decision-making [19].

Informal discussions on other study aspects, MDM initiatives, and creating off-farm job opportunities at community level, and inter-linkages among all four marketing interventions for bringing sustainability in traditional farming and food systems were also held, and output analyzed and discussed on scientific lines.

As the research design of the present study was based on an exploratory survey, it was not so easy to statistically analyze data elicited through focus group discussion meetings and the subjective judgements. For quantitative data, recorded as percentage, original values without transformation and normality test have been presented. Only standard deviation (SD) was computed for the sample data sets.

3. Results

3.1. General Agrifood Policy Inputs Relevant to Traditional Farming Agroecologies

The farmer HH response on various policy input variables, as listed in Table 1, indicated that farming communities have enough experiential knowledge on traditional farming practices. The merit in each farming action could be easily interpreted on sound scientific principles for integrating various "add-value" interventions.

Table 1. General agrifood policy input questionnaires relevant to small-holder farming.

S. No.	Policy Variables
1.	Is diversity of crops or crop landraces/farmers' varieties (FV) a necessity or a choice for farmer households (HHs)? Are farmer HHs familiar with matrix ranking of selections criteria for the FV diversity they maintain?
2.	Are crop production and consumption decisions at farmer HH level linked?
3.	How important are livestock in traditional farming landscapes?
4.	Is net output per unit area more under traditional farming or under improved/cash crop farming?
5.	How important is nutritional security for farmer HHs? Is native crop diversity really contributing to the nutritional security of farmer HHs?
6.	Is the cash crop economy resulting in nutrition transition at farmer HH level leading ultimately to malnutrition?
7.	Is farming a full-time employment for farmer HHs?
8.	What are the possible community-level off-farm employment opportunities that can contribute to farmer livelihood security?
9.	How important are common property resources (CPRs) in farming landscapes for farmer HHs?
10.	How important are wild plant food resources in traditional farming landscapes?
11.	What are the possible ways by which native farming communities can benefit by getting premium price for their local produce?
12.	Do farmers understand about globalization? How globalization is affecting household food choices in rural communities?
13.	Is revitalization of traditional farming possible and are farmer HHs ready for that?

14.	Are the advocacy campaigns at community level for cross-sectoral collaboration among agriculture, nutrition, and health needed?
15.	How important is agriculture-related local ecological knowledge (LEK)? Is there loss of LEK?

* The information documented from about 1000 farmer HH representatives.

In most small-holder traditional farming agroecologies, there are no well-developed markets for traditional crops. The crop production and consumption decisions of farmer households are often linked. The consumption preferences continue to influence these decisions. The surplus crop produce is sold locally in the community, sometimes through bartering. Profit maximization has never been the production objectives of the farmer households and market prices are a small fraction of the private incentive that farmers attach to maintaining crop diversity. Cultural and consumption preferences, therefore, play a major role in the decision-making of farmer households. Maintaining crop landrace diversity in traditional farming landscapes, however, has public incentives for farmers and society. Genetic diversity in crop landrace populations has substantially contributed to adaptive response to the changing climate and also has the potential to generate novel variations needed to maintain the capacity of crops to adapt to change. The traditional farming systems thus provide an evolutionary service to the society.

The traditional agriculture in all agroecologies is largely organic, with limited use of purchased inputs. Formal expansion of organic farming in the traditional production areas, which relies on ecological processes, biodiversity, and cropping cycles that are adapted to local conditions and generally excludes or strictly limits the use of agrichemical inputs, will benefit the economy in terms of greater employment and business diversification. Positive-sum employment gains are expected in organic farming and local food systems, as organic farms are more labor-intensive than conventional industrialized production. In addition, there are also incremental positive impacts on job creation in both on-farm processing (e.g., quality sorting and special handling) and non-farm production of organic agricultural inputs (e.g., natural fertilizers) and post-harvest farm-to-market supply chains. Therefore, rather than displacing the agricultural workforce, a greener agriculture safeguards livelihood by keeping people on the land and realizing a broad range of livelihoods on the basis of its enhanced productivity. Additionally, it was revealed that organic farming yields more total food produced than conventional industrialized farming on the same amount of land. Further, the organically grown traditional food is considered nutritious and a food-based approach towards community nutrition and health can be easily advocated in traditional agricultural landscapes.

The traditional farming communities source several wild plant food resources as components of their dietary diversity and livelihood security. Loss of common property resources (CPRs) and natural habitats, however, have negatively impacted the availability of wild plants and other food resources over the years.

In every farming agroecology, there are several crop landraces/farmers' varieties (FV) which can fetch premium price in local and distant markets through proper processing, packaging, and labeling. Many of the native crops, including native herbs, cultivated and foraged from the wild, have great economic incentives for farmer HHs.

The impact of globalization is evident now, even in rural farming communities of all agroecologies. Junk food producers are very aggressive marketers and often make misleading claims and often target their marketing specifically towards children. However, the accessibility of fast/junk food is relatively low in local rural markets. With a strong native food culture and traditions still prevailing in traditional farming communities, revitalization of traditional food habits is a huge possibility under eco-nutrition framework. A strong need for cross-sectoral collaboration among agriculture, nutrition, and health was felt among traditional farming communities. The nutrition database of traditional crops and FV is expected to be very helpful for advocacy campaigns.

Agriculture-related local ecological knowledge (LEK) was reported to be very important. However, a negative correlation was found between LEK and the education and wealth level of farmer HHs. Loss of LEK was reported for food recipes, wild plant food recognition and uses, traditional livestock healthcare, etc.

Based on farmers' inputs, about 80% of households have crop-livestock mixed farming in all agroecologies, the remaining 20% engaged either in crop production or livestock production alone (Table 2). Livestock, therefore, are an integral sector of all traditional farming agroecologies. Further, the purpose of traditional crop production for about 90% households was mainly for their own consumption (subsistence) and only the surplus production was for sale (Table 3). It is hoped that with some "localized" marketing interventions more farmer households can grow crops for sale so that traditional agriculture is more profitable and sustainable.

Table 2. Main agricultural activity of farmer households (HHs) in different farming agroecologies.

Main Agricultural Activity	Farmer HHs in Different Agroecologies (%)			
	Hill and Mountain	Hot Arid Desert	Central Plateau Region	North-Eastern Region
1. Mainly crop production	8.8 (±2.9)	7.3 (±1.3)	8.5 (±2.9)	9.5 (±3.3)
2. Mainly livestock production	7.8 (±2.7)	13.0 (±1.2)	10.3 (±2.6)	11.3 (±2.2)
3. Mixed (crop and livestock)	83.4 (±2.3)	79.7 (±1.5)	81.2 (±2.8)	79.2 (±3.0)

Table 3. Purpose of crop production in different farming agroecologies.

Purpose of Crop Production	Farmer HHs in different agroecologies (%)			
	Hill and Mountain	Hot Arid Desert	Central Plateau Region	North-Eastern Region
1. Producing only for sale	-	-	-	-
2. Producing mainly for sale with some own consumption	8.8 (±3.3)	8.5 (±3.1)	8.2 (±2.1)	7.8 (±2.1)
3. Producing mainly for own consumption with some sales	71.2 (±7.7)	70.5 (±4.2)	63.8 (±7.5)	70.0 (±4.1)
4. Producing only for own consumption	20.0 (±4.9)	21.0 (±3.9)	28.0 (±6.1)	22.3 (±4.0)

The three community-level "localized" marketing interventions viz. linking traditional farming with CSA initiatives, linking small-holder farming with school meal (MDM) programme, and value chain development of local farm produce will make traditional small-holder farming more sustainable and profitable. These interventions will also generate enough green jobs at community level for the rural youths.

3.2. Promoting Community Supported Agriculture (CSA) Initiatives

About 90% of the rural HHs, in the present study sites, are directly or indirectly engaged in farming activities and there is no formal awareness among the rural communities about CSA initiatives. Using a participatory approach, the phenomena of CSA was therefore investigated to ascertain:

Is CSA a possibility to effectively revive traditional agriculture for better livelihood security of native farming communities?
Can CSA be a transformational act for producers and consumers supporting food system changes?

As agriculture underpins the household economies of all these agroecologies, CSA can become a model for a much-needed shift towards a truly sustainable economy on a human scale. CSA initiatives are less exposed to market pressures, and thus offer much more freedom for experimentation in agricultural practices.

Table 4 presents the preference expressed for the type of CSA in different agroecologies in the context of smallholder farmer households. In order of ranking, from the most to the least popular, the most preferred types of CSA in all agroecologies was: farmer cooperatives (where the farmers pool their resources to supply consumers), followed by subscription or farmer-driven (the farmer organizes the CSA and makes most of the management decisions, the shareholder or subscriber has minimal involvement in the farm), shareholder or consumer-driven, and lastly farmer-consumer cooperatives. The fact that Farmer Cooperatives received the highest preference gives us a clear indication that collective farming by pooling their resources is the best possible way for the demands of urban consumers to be easily met under small-holder Indian farming.

Table 4. Preference for the type of Community Supported Agriculture (CSA) intervention in different agroecologies.

Type of CSA	HH Preference (%) in Different Agroecologies			
	Hill and Mountain	**Hot arid Desert**	**Central Plateau Region**	**North-Eastern Region**
1. Subscription or farmer-driven	33.1 (±3.0)	39.0 (±3.3)	41.0 (±2.5)	42.0 (±2.2)
2. Shareholder or consumer-driven	9.2 (±1.3)	5.0 (±1.3)	4.5 (±1.3)	4.0 (±1.0)
3. Farmer cooperative	51.5 (±2.0)	53.0 (±3.1)	52.0 (±3.8)	52.0 (±3.6)
4. Farmer-consumer cooperative	6.2 (±1.3)	3.0 (±1.0)	2.5 (±1.0)	2.0 (±1.0)

Forming a farmer cooperative of 10–15 member HHs per village will be the first step. In small-holder farming landscapes, pooling the village land will be the next important step. Even land of two to three villages can be pooled in cases of extremely small holdings. The farmer cooperatives will then mobilize local resources for collective farming at each village. Mobilizing urban consumers to become CSA members will be another requirement, including finalizing the membership share. The pooled farm will offer a certain number of "shares" to the urban consumers and commit to growing food for the participating members. The surplus produce after household consumption will only be supplied to urban consumers/participating members. The general ignorance of the nature and use of nutrient-rich indigenous and traditional food resources over the years has resulted in these foods being left out of most nutritional strategies put in place to address food security and nutrition problems of the local population.

The potential barriers to entry in a CSA are finding consumers willing to be part of a CSA, followed by consumers' lack of familiarity with biodiverse food. The education level of consumers was the most significant predictor of membership status, with probable members generally having a higher level of education, who want organically grown fresh food and who are socially conscious.

Priority ranking of attitudes and values among members, and motivations of consumers for being a CSA farm member, are presented in Table 5. It is evident from Table 5 that both the producers and consumers are well aware of the multiple benefits of CSA initiatives with regard to nutrition, health, education on LEK related to agriculture and food, the desire of a social community to engage around food, environment and agriculture, etc.

Table 5. Priority ranking of attitudes and values among members, and consumers' motivations for being a CSA farm member.

Priority Rank	Attitudes and Values among CSA Members, and Motivations for being a CSA Farm Member
	• **Attitudes and Values among CSA Members**
1	Political will to give priority to environmental issues to a much greater extent
2	Feeling oneself to be environmentally engaged
3	Consume organic/biodynamic food as far as possible
4	Support to local agriculture
5	Reduce consumption of meat in favor of the environment, health, and/or animals
6	Organic food is cheaper from the farm than it is in the grocery store.
	• **Motivations for Being Member of a CSA Farm**
1	Practicing environmentally-friendly actions
2	Having access to local food
3	The desire to increase the consumption of organic/biodynamic food
4	To get a better selection of organic foods
5	Enhanced understanding of local food resources and LEK
6	The desire to support local business and value creation
7	Concern about climate change
8	The desire of a social community around food, environment, and agriculture.

3.3. Linking Smallholder Farming to School Meal (MDM) Programme

India's midday meal (MDM) programme covers all children studying in Government, Local Body, and Government-aided primary and upper primary schools across the country, including the present study sites. The caloric value of a midday meal at upper primary stage has been fixed at a minimum of 700 calories, with 20 grams of protein by providing 150 grams of food grains (rice/wheat) per child/school day.

Farmers understand that the stress on India's agriculture is a result of unrealistic policies, poor investment, and lax implementation of relief schemes. The sector runs on a system mired by corruption, skewed against smallholder and marginal farmers in almost every possible way. Hence, linking of traditional smallholder farming with the MDM scheme might work in favor of these smallholder and marginal cultivators. Providing local agricultural produce to primary and middle schools will guarantee a steady and much needed income. However, the supply chain, which is an intricate network of middlemen who buy from farmers and sell agricultural produce at manipulated prices, will be a major obstacle. Farmers find it increasingly difficult to cut out middlemen and trade at fair prices. Local governments need to deal directly with farmers and ensure that they are not cheated out of a fair price.

Results of farmer interactions on prioritization of probable food items sourced from farmer HHs for school meal (MDM) initiatives in different Indian agroecologies and the willingness of farmer HHs for procurement modalities of food resources by local authorities are presented in Table 6.

Table 6. Prioritization* of probable food items sourced from farmer HHs for MDM initiatives in different agroecologies** and procurement modalities.

Sourcing Local Food Resources and Procurement Modalities	AE 1	AE 2	AE 3	AE 4
Local Food Resources to be Sourced				
- Native millets	High	High	High	Low
- Rice (red rice, local aromatic types)	High	Low	High	High
- Wheat (Local landraces)	Moderate	Moderate	Moderate	Moderate
- Native legumes/pulses	High	High	High	High
- Leafy greens	High	High	High	High
- Native fruits	High	High	Moderate	High
- Tubers, yams	High	Moderate	Moderate	High

- Milk and milk products	High	High	High	High
- Eggs	Moderate	High	High	High
- Wild plant food resources in agricultural systems	High	High	High	high
Procurement Modalities				
- Willingness of farmers to sell produce for MDM rather than local markets	High	High	High	High
- Willingness to introduce more/new crops in production system, if the programme requires	High	Moderate	High	High
- Willingness to form farmer-cooperatives in which farmers of the entire village pool their produce to supply for MDM	High	High	High	High

***** High (>60% HHs favoring the intervention), Moderate (30%–60% favoring the intervention), Low (<30% favoring the intervention). ** AE 1: Hill and mountain; AE 2: Hot arid desert; AE 3: Central plateau region; AE4: North-eastern region; the information documented from about 1000 farmer HH representatives.

A critical analysis of centralized versus localized purchase of food items for MDM is presented in Table 7. While interacting with members of School Management Committees at village level for MDM, some untoward incidents viz. instances of unhygienic food served, children falling ill, sub-standard supplies, diversion/ misuse of resources, social discrimination, etc., were reported under the centralized procurement presently in operation.

Table 7. Salient features of centralized versus localized procurement of food items for MDM.

Sourcing of Food Items for MDM.
Centralized Purchase
• Centralized purchase of food items and mandatory fortification undermines native food culture, biodiversity, and local livelihood.
• Pre-packaged or ready to eat foods in the name of fortification and addition of supplements are poor in nutrition and compromise the health of school children.
• Supply of poor quality food grains; instances of unhygienic food served, children falling ill, sub-standard supplies; diversion/misuse of resources; social discrimination, and inadequate monitoring and evaluation.
Localized Purchase
• Localized procurement of food items will strengthen decentralized decision-making, the focus is on smallholder and marginal farmers and on ensuring strict monitoring at every stage of procurement and payment.
• A structured demand will guarantee large and predictable sources of demand to smallholder or marginal farmers, thereby giving them security of income.
• Local purchase enables smallholder farmers and famer cooperatives make a contract with the government for a stipulated amount of produce at a fixed price in advance.
• Farmers/farmer cooperatives negotiate directly with local authorities, eliminating their dependence on middlemen.
• Local procurement will reduce transportation cost and losses.
• Local sourcing will allow the use of nutritious coarse grains (native millets) that have ecological and health benefits, only wheat and rice are currently being supplied under centralized purchase.
• Local sourcing of food items will facilitate introducing organic food under MDM.
• The procurement of local organic food will bring in menu diversity, particularly with respect to fruits and vegetables.
• Organic farming can be a mass movement if more farmers adopt it, which can happen only if their produce finds a market, MDM can play a big role by providing much-needed assured markets.
• With proof of fixed yearly income, farmers/farmer cooperatives can apply for credit, invest in better farming interventions and even obtain formal land title deeds to lands that have been abandoned within certain areas, for example in Uttarakhand hills, due to permanent migration.

The quality of food provided to children through the MDM plan has to be high and organically produced to improve their nutritional status. The focus should be on smallholder and marginal farmers and on ensuring strict monitoring at every stage of procurement and payment. A structured demand will guarantee large and predictable sources of demand to smallholder or marginal farmers, thereby giving them security of income. Famer cooperatives should make a contract with the government for a stipulated amount of produce at a fixed price in advance. Farmers/farmer cooperatives negotiate directly with local authorities, eliminating their dependence on middlemen. With proof of fixed yearly income, farmers/farmer cooperatives can apply for credit, invest in better farming interventions, and even obtain formal land title deeds to lands that have been abandoned within certain areas, for example, in Uttarakhand hills, due to permanent out-migration. The programme is expected to encourage more farmers to retain their land and continue farming instead of migrating to urban areas and big cities in search of non-farm employment.

3.4. Enhanced Market Access and Value Chain Development for Local Plant Food Resources

It is now well recognized that our current food system is flawed. Cheap, energy-dense foods of low nutritional value are readily available but consumers often struggle to access nutritious foods at an affordable price. Moreover, our study is indicating that undernutrition is widespread, particularly in urban dwellings of all these agroecologies. All these agroecologies face the challenge of simultaneously tackling undernutrition and the growing burden of diet-related non-communicable diseases. System changes are needed to ensure that the food supply can deliver the diverse, high-quality foods needed to promote good nutrition and health. The incentives in our current food system are misaligned: there is a disconnect between what is produced and what is recommended for good nutrition.

In general, fruits and vegetables were the main produce marketed in all studied agroecologies through three channels: (i) farmers producing and selling their own traditional vegetables and fruits directly to consumers as market retailers or street vendors; (ii) farmers selling to retailers; and (iii) farmers selling to middlemen (collectors).

Interacting with farmer households in FGD meetings revealed that traditional landraces of different native crops in all of the agroecologies not only have different genetic attributes to modern varieties, they are also different in consumption characteristics, such as nutrition, taste, aroma, and cooking quality. Partly for this reason—and partly by virtue of commitments to environmental values—there is scope to develop local and distant markets in which traditional varieties command a premium price. Labeling systems can assist in creating such markets. Again, this would not only provide direct rewards to growers, but also help to raise public consciousness of the importance of diversity and the need for public policies to sustain and promote it.

The native crops from all four agroecologies have a greater potential for value chain development and other marketing interventions. These include: finger millet or *madua*; local red rice; local black-seeded soybean or *bhat*; *gahat* or horse gram, from traditional hill farming areas of Uttarakhand; pearl millet or bajra; moth bean, mung bean, sesame, mustard, from arid desert; rice, pigeon pea, urd bean or black gram, mung bean or green gram, from the central plateau region; and native rice landraces from the north-eastern region. Local fruits and vegetables, which are rich sources of minerals and micronutrients, also have a great potential for value chain development in all Indian agroecologies.

There are many other minor or underutilized crops, as well as many wild plant food resources foraged in the community from agroforestry systems and wild habitats in all these agroecologies that have immense economic potential to be sold, particularly in local markets.

In many instances it may be difficult to secure stable markets for raw agricultural products. This is particularly the case for crops/commodities that require processing before they can be used. In these cases, it may be possible to enhance the benefits to farmers of local resources by processing them for particular markets.

The key considerations in value chain development of traditional food resources might include (i) making value chains more nutrition-sensitive, which can help improve the quality of the foods

that are available, affordable, and acceptable; (ii) value chain analysis, which can be used in the context of both undernutrition and overweight and obesity, and in low-, middle-, and high-income consumer contexts; (iii) value chain analysis, which can be used to examine the incentives and disincentives for the production and consumption of nutritious foods, and can help to inform interventions aimed at improving access to them.

3.5. Off-Farm Employment for Rural Youth at Community Level

The relative contribution of farming to overall household economy in different agroecologies and the state of permanent outmigration are presented in Table 8. A small fraction of households (on average, 12.75%) earn their livelihoods (cash income) entirely from farming; 54.25% households earn most of their cash income from farming; and 33% households derive most of their cash income from non-farm sources. Therefore, the expansion of non-farm employment at community level poses no threat towards eliminating farming. It is clear from Table 8 that farming need not be recognized as an all-or-nothing occupational choice and may be treated as "part-time".

Table 8. Exploratory survey of farmer HHs livelihood in different agroecologies and state of permanent outmigration.

Agroecology	HHs Earning Their Livelihood Entirely from Farming (%)	HHs Earning Most of Their Livelihood from Farming (%)	HHs Earning Most of Their Livelihood from Non-Farm Sources (%)	Permanent Out-Migration to Urban Areas
Hill and mountain[1]	10	50	40	20
Hot arid desert[2]	12	52	36	Nil
Central plateau region[3]	14	56	30	Nil
North-eastern region[4]	15	59	26	Nil
Mean	12.75 (±2.21)	54.25 (±4.03)	33.00 (±6.21)	-

[1]Representative agroecologies of entire Uttarakhand; [2]Parts of rural Jodhpur in western Rajasthan; [3]Parts of tribal Umaria district in M.P.; [4]Parts of Assam-Jorhat and Golaghat; FGD meetings were organized in all these four agroecologies and a total of about 1000 farmer HHs were involved these interaction meetings.

Furthermore, with the exception of the hill and mountain agroecology of Uttarakhand state, no permanent migration was recorded from the other three agroecologies. Seasonal migration is, however, a common phenomenon and widespread across all agroecologies. Migrant labor helps to raise households' income levels. We found a positive association between farm household size and off-farm employment. Migrant labor is a compensating mechanism used by households to reduce their disadvantageous position. Migrant households are characterized by lower education levels, lower levels of income from agriculture, and by a remote geographical location. However, those households sending migrant labor were found to have higher income levels than those not sending migrant labor. Income from migrant labor accounts for almost 50% of the total annual cash income of households sending at least one migrant laborer. Farm size seems to negatively affect off-farm labor participation in all agroecologies.

Probable areas where enhanced job opportunities occur in small-holder traditional farming are listed in Table 9. Organic farming, agro-ecotourism, women-centric off-farm jobs by forming self-help groups (SHGs), and community managed CPRs, agro-forestry and forestry interventions are important areas where the rural workforce can be effectively engaged for year-round employment at their door steps.

Table 9. Probable areas/sectors where job opportunities at community level exist in small-holder farming.

Probable Areas	Job Opportunities and Policy Support
Organic farming	• Production of organic agricultural inputs. • Post-harvest farm-to-market supply chains. • Linking organic farming to marketing interventions. • Infrastructure development like cold stores to avoid post-harvest losses.
Agro-ecotourism	• Linking ecotourism to traditional farming landscapes. • Developing herbal farms, food parks, biodiversity parks, sacred grooves, fish farms, wild life parks, rural game parks in agricultural landscapes near to ecotourism sites. • Training the local youths in hospitality management and environmental education.
Women-centric jobs, viz. embroidery, tailoring, weaving, patchwork, applique, handicraft, etc.	• Creating women-centric jobs by forming self-help groups (SHGs). • Requisite skill development and making available all need-based equipment/resources at subsidized rates.
Management of Common Property Resources (CPRs)/agroforestry species/community forests	• Nursery raising and planting of agroforestry species. • Planting diverse tree species and maintaining diverse economically important species at CPRs.

Organic farming is highly labor-intensive and linking organic food to some marketing interventions through policy support will make native farming and food systems sustainable. Table 10 lists how organic farming can be effectively linked to marketing interventions through community level actions and enabling policy support. Enough jobs are likely to be generated for specific organic farming interventions.

Table 10. Linking organic farming to marketing interventions, community level actions, and policy support.

Linking Organic Farming to Market-Oriented Initiatives	Actions at Community Level and Policy Support
Community-Supported Agriculture (CSA) initiatives	• Facilitate forming village-level farmer cooperatives. • Consolidation and pooling of farm land for collective farming. • Awareness campaigns for popularizing the nutritional superiority of organically-grown native crops among urban consumers. • Mobilizing urban consumers become CSA members.
Linking organic food to school meal (MDM) programmes	• Empowering the local district administrations to make changes to the menu of MDM served in government schools to suit the local tastes. • Divert a substantial Ministry of Human Resource Development (MHRD) budget for local purchasing of native healthy food for MDM directly from small-holder native farmers.
Enhanced market access and value chain development for local plant food resources	• Make food-based approach as major initiative for household nutrition and health. • Where there is no secure market for raw produce, build capacity of farmers for processing/packaging to enhance benefit from localized sale.

Agro-ecotourism is the latest concept in the Indian tourism industry, which normally occurs on farms. It gives the farming community an opportunity to ensure additional jobs, additional income, and an avenue for direct marketing to the visitors. Agro-ecotourism can deliver more benefits to native people through employment, strengthening the local food supply chain, providing assistance with enterprise formation, and supporting local services and infrastructure. Agro-ecotourism can be linked to eco-tourism, as all agroecologies have many ecotourism sites (Table 11) around which agricultural landscapes can be developed.

Table 11. Ecotourism sites of visitors' interest in different agroecologies of India.

Agroecologies	Famous Ecotourism Sites Where Agro-Ecotourism Can be Developed
Hill and mountain agroecology (Uttarakhand)	Nandadevi National Park, Valley of Flowers National Park, Binsar Wild Life Sanctuary, Gangotri National Park, Askot Sanctuary, Kanchula Korak Muskdeer Sanctuary, Govind Pashu Vihar Wildlife Sactuary, Benog Wildlife Sanctuary, Jabarkhet Wildlife Reserve, Corbett National Park, Rajaji National Park
Arid desert (Rajasthan)	Bharatpur Bird Sanctuary, Ranthambore Tiger Reserve, Sariska Tiger Reserve, Desert National Park, Keoladeo Ghana National Park, Todgarh-Raoli Wildlife Sactuary, Mount-abu Wildlife Sanctuary, Jhalana Nature Trail
Central plateau region (Madhya Pradesh)	Kanha Tiger Reserve, Satpura Tiger Reserve, Dumna Nature Reserve, Samardha Jungle Camp, Kerwa Jungle Camp, Kathotia Jungle Camp, Kukru Jungle Camp, Deori National Chambal Sanctuary, Tighra Jungle Camp, Ghughua Fossil Park.
North-eastern region (Assam)	Kaziranga National Park, Manas National Park, Dibru Saikhowa National Park, Nameri National Park, Orang National Park

The benefits of agro-ecotourism to visitors and society, in general, are presented in Table 12. All these agroecologies, bestowed with natural scenic beauty, have immense possibility of job creation for rural youths.

Table 12. Benefits of agro-ecotourism to visitors and society, in general.

Benefits of Agro-Ecotourism
Benefits to Visitors
• Guided and non-guided treks through villages to meet people of social/ethnic groups to learn about their farming practices, belief, dress, tradition, culture, custom, etc.
• Participation in traditional agricultural activities, such as ploughing, sowing, harvesting, care for family livestock.
• Participating in agricultural operations, organic farming, cooking, trekking, and participating in the rural games.
• Visiting local artisans/craftsman and learning about their traditional skills.
• Visiting local folk medicine men, *vaidyas*, and gaining knowledge about the curative properties of native food and medicinal herbs.
• Learning about local recipes, local flavoring spices, home-processed food products, and tasting village cuisines.
• Buying local handicraft products, dress materials, farm gate fresh agriculture products, processed local foods, etc.
Societal Benefits
• Minimizing the negative impact of present-day conventional tourism upon the natural and socio-cultural environment.
• Conserving the native plant diversity and traditional cultures prevailing in the region.
• Providing employment opportunities to native communities as a family business—entrepreneurship development.
• Sustainable rural development.
• According dignity to the traditional farming sector and indigenous food sovereignty.

Women's importance in agricultural production, both as workers and as farm managers, has been growing in the last two decades, as more men move to non-farm jobs, leading to an increased feminization of agriculture. Table 13 presents the women workforce engaged in agriculture operations in different agroecologies and contribution of women SHGs to HH cash income. We recorded an average 72% women workforce engaged in agricultural operations, as against 49% men

in the farming agroecologies under study, and this gap has been rising over the years. Farming alone is, however, not a full-time employment for women farmers as well. As the traditional agriculture is subsistence and largely "part-time", there are limited earning opportunities even for women farmers in rural areas. The emergence of women self-help groups (SHGs) has come as a major financial respite and job opportunity for the women workforce at their door step.

Table 13. Agriculture workforce in different agroecologies and contribution of women SHG to HH cash income.

Agroecologies	Agriculture Workforce		Contribution of Women SHG to HH Cash Income (%)
	Men (%)	Women (%)	
Hill and mountain agroecology (Uttarakhand)	36	62	15
Arid desert (Rajasthan)	56	78	7
Central plateau region (Madhya Pradesh)	54	80	8
North-eastern region (Assam)	51	72	12
Mean	49.3 (±9.0)	73.0 (±8.1)	10.5 (±3.7)

SHGs are bringing women together under a common platform. In addition to their farming skills, women are learning stitching, embroidery, patchwork, weaving, food-processing (making use of their locally-available resources), handicrafts, etc. Women enjoy the learning opportunity as well as the quality time spent together. Working for few hours a day for certain days (7–10) in a month, the women associated with the group earn a decent amount. The women SHGs contribute about 10% of the household cash income (Table 13). It has given them respect and increased their say in the decision-making of family matters.

Community-managed CPRs, agroforestry, and forestry are also expected to generate enough employment at community level and help address sustainable farming and food systems in small-holder Indian agroecologies. In the crop-livestock mixed farming, revival of CPRs is considered very important, as CPRs are an important source of fodder for livestock and wild plant food resources for human consumption. Similarly, the adoption of agroforestry practices creates employment opportunities with regards to the management of seedling farms for the recommended tree species, increased labor for pruning, and harvesting of firewood and other products from the tree stands.

4. Discussion

4.1. General Agrifood Policy Inputs Relevant to Traditional Farming Agroecologies

The traditional smallholder farming in all agroecologies assessed in the present study is biodiverse, showing that enough crop diversity, at both species and varietal level, is maintained in production landscapes. The diversity in traditional agricultural production systems has been reported to be a necessity rather than a choice for farmer HHs [1]. Crop-livestock small-scale mixed farming is commonly practiced across all agroecologies. Farming is predominantly rainfed. Wild plant food resources, which are often undervalued, also form an important component of farmer HH dietary diversity and livelihood security, for those who rely solely on them.

The important feature characterizing these traditional farming agroecologies has been econutrition, integrating agriculture with environment, health, and sustainability. Traditional rainfed agriculture is mainly subsistence and contributes minimally to household cash income. Lack of economic incentives in agricultural training have been the main reason for the ignorance of rural

youth towards traditional farming in all these agroecologies. This often leads to permanent out-migration, as was evident in the hill and mountain agroecology studied [3].

Farmers understand, however, that with strong political will and policy support there is a huge possibility that traditional farming can be easily revived by making it more market-oriented.

4.2. Promoting Community-Supported Agriculture (CSA) Initiatives

It has long been argued that, in order to sustain agriculture communities, the balance between local self-sufficiency and global dependence needs to be veered back towards the local, rather than continuing on its present trajectory towards the global [20]. Local food systems are characterized by smaller and diverse farms, trust, and networks rather than a few larger and specialized farms, large corporations, and lack of power for farmers, consumers, and local communities to shape their development. Today, consumers have declined trust in food when it comes to environment, health, and animal welfare, reinforced by incidents of food scandals in the industrialized and globalized food systems [21–23].

It is also being argued that the industrial production and long food supply chains are pushing organic farming away from its original ideology and disentangling it from the locality [24–26]. These factors together are resulting in the emergence of alternative food networks with short food supply chains, like farmers' markets, farm shops, subscription box schemes, and CSA [26,27]. These arrangements are allowing closer relationships between producer and consumer and are, to a larger extent, supporting sustainable farming and consumption.

Through CSA initiatives, farmers and consumers involved can be seen as part of a larger alternative food movement in opposition to industrialized agriculture and a globalized food system with its current power relations. Farmers and most consumers are attracted to the CSA model worldwide, seeking alternative ways to produce, consume, and communicate around food, where they are actively defining the agenda, and with a focus on food security. They want to bring forth fresh, safe, and locally-produced food that is produced with care for environment, health, justice, and animal welfare. Priority ranking of attitudes and values among members, and motivations of consumers for being a CSA farm member, as enumerated in the Norwegian context [26], could be duly highlighted here, quite befitting in the context of the present study in distinct Indian traditional farming agroecologies. As the urban consumers are more environmentally conscious now and attach greater importance to traditional agriculture, thus the prospects of CSA seem highly encouraging.

CSA offers an alternative approach to agriculture, based on solidarity, direct human relationships, mutual trust, small scale, and respect for the environment [28]. While, so far, most CSAs are based on vegetable production, a wide range of other agricultural produce is increasingly being covered. In this context, it is interesting to note that there are initiatives that have set up community-supported beekeeping, community-supported bakeries, and community-supported fisheries, etc., in Europe, for example [29].

It has also been rightly argued by those concerned with the global food-sovereignty movement that it is the small-scale farmers that actually have control of the food system, of information, and of food culture as against the social perception in the Northern hemisphere that the large food chains feed society [30]. Facing this, in the entire world, and especially in the Northern hemisphere of USA, Canada, and Europe, impressive associations of critical consumers and producers are being developed. In France, for example, there are 3000 producer-consumer associations. In Canada and the USA, where there is a common problem of reduced numbers of farmers, there is an enormous demand from citizens to have control over what they eat, how it is produced, and who produces it. They are demanding a new model of farmer, one that is not trained in a productivist model [30].

4.3. Linking Traditional Agriculture with the School Meal (MDM) Programme

A crucial step in enhancing the nutritional standards of MDM in traditional farming agroecologies of India would be through the introduction of local millets, red and brown rice, native pulses, fruits, vegetables, etc. These traditional crops have proven superior nutritional value,

naturally enriched with macro- and micronutrients, proteins, minerals, iron, calcium, zinc, dietary fibres, minerals, phosphorus, potassium, vitamin B, and essential amino acids.

Structured demand guarantees large yet predictable sources of demand to smallholder or marginal farmers, thereby giving them income security. Under PNAE of Brazil, family farmers and famer cooperatives sign a contract with the government for a stipulated amount of produce at a fixed price in advance. Farmers negotiate directly with local authorities, eliminating their dependence on middlemen. Additionally, with proof of fixed yearly income, they can now apply for credit, invest in better farming technology, and even obtain formal land title deeds to lands they previously leased from the state. The programme is also encouraging more farmers to hold on to their land and continue farming instead of migrating to cities in search of off-farm employment. According to a report by Thomson Reuter Foundation, due to the priority given to farmers under this programme, their income has seen a considerable rise (average 43%) over the past few years.

Following the cooperative model would be better, as farmers would retain bargaining power in the supply chain. A state federation of farmers can negotiate the prices with government representatives. District unions could be responsible for the procurement and delivery of produce from village cooperatives to city governments. As for local schools in villages, the cooperatives themselves could supply the commodities based on the requirement, which is how it works in Brazil. However, the execution of the tasks involved, especially paperwork and bureaucratic obligations, will not be easy to execute. The process will need to be supported by the state in the form of officials who can train and assist farmers in understanding and navigating the logistics.

The quality of food provided to children through the midday meal programme has to be high if their nutritional status is to improve. The city of São Paulo in Brazil only buys organic rice from farmers, despite it being 30 percent more expensive. A similar shift towards organic farming can be encouraged in our country by giving preference to farmers who produce food organically. Again, this would require research and extension to be provided by the state government. Partnering with NGOs to aid farmers in the transition would be a plus and also take a certain amount of the burden off state governments.

If farmers are successfully integrated into the midday meal plan, cultivation will no longer be a gamble on their part. They will only produce the amount required and receive assured returns. However, the union government has to make farmer involvement compulsory for the programme. Additionally, the focus should be on smallholder and marginal farmers and on ensuring strict monitoring at every stage of procurement and payment. Eventually, such contracts could also be extended from school meals to include public colleges, offices, and hospitals.

For a school meal scheme to be a success for both children and farmers, like Brazil's PNAE, existing structural loopholes in both the education and agricultural sectors have to be plugged. There needs to be enough working schools for it to reach and benefit students and farmers all over the country. Brazil has its share of poverty and hunger to fight against, but it still manages to keep the school meal plan functional. It will take a high level of commitment and capital investment for an initiative like that to take off in our country, but if the results are positive, several social and economic issues will be tackled in one go. It certainly is an idea worth considering.

4.4. Enhanced Market Access and Value Chain Development for Local Plant Food Resources

Enhanced "localized" market access and value chain development for local plant food resources can be another important initiative, making traditional agriculture in Indian agroecologies sustainable. Interaction with farmer households at various study sites, we found that there is enough scope for development of local and distant markets in which traditional varieties command a price premium. The native crops from traditional farming areas have a greater potential for value chain development and other marketing interventions. With enhanced awareness about the nutritional importance of local crops in the community, in well-functioning markets, the native crop landraces can be competitive and have enough potential to provide commercial opportunities fetching a premium price. Labeling systems can assist in creating such markets. Again, this could not only provide direct rewards to growers, but also help to raise public consciousness of the importance of

diversity and the need for public policies to sustain it. In many instances it may be difficult to secure stable markets for raw agricultural products. This is particularly the case for crops requiring processing before they can be used. In these cases, it may be possible to enhance the benefits to farmers of local varieties by processing them for particular market.

Value chains are not a new concept, and many working in agriculture and business have been not only utilizing this concept, but also putting value chains into practical use. Yet, very little has been done to ensure that nutrition is included in the chain. This is probably a reflection of the cross-disciplinary nature of food value chains.

In low- and middle-income countries, the food value chain approach has mainly been considered with a view to improving the economic outcomes of cash cropping systems. More can be done within the value chain model, however, including ensuring that better partnerships with discrete sets of players can add value by introducing more nutrition into the value chain. By including nutrition as an outcome of value chains, the supply and demand 'ends' of the chain can be linked, with a view to ensuring that the nutritional needs of the population are met. To look at food value chains via a nutrition 'lens', therefore, the demand side of the equation and the overall linkages of value chains to the food environment must also be taken into account.

Hanf and Gagalyuk [31] demonstrated how small- and medium-sized food processors manage to install effective procurement systems in the weak institutional environments of Eastern European and Central Asian (EECA) countries. Swinnen et al. [32] reviewed the constraints to smallholder participation in high value agriculture in West Africa.

Analysis of food value chains requires an understanding of nutrition, agriculture, food technology, economics, and marketing, among other things. However, the training received by nutritionists in these other areas is often inadequate for this task. For this reason, many unanswered questions exist that require further research. Nevertheless, food value chains for nutrition have a role to play in terms of identifying innovative ways of improving the availability, affordability, and acceptability of nutritious foods, both in the context of undernutrition and in the context of overweight/obesity, and there is currently a push for conducting food value chain analyses in an integrated manner with various stakeholders. This will require buy-in from various actors in the value chain and will need to target both supply- and demand-driven dynamics.

4.5. Off-Farm Employment for Rural Youth at Community Level

Farm and non-farm employment opportunities at community level for rural youths is considered very vital to bring sustainability to agricultural production. Policies that help to generate part-time, farm, and non-farm employment at community level in rural areas can, therefore, help sustain small farms. Organic farming; agro-ecotourism; women-centric SHGs for several non-farm jobs viz. embroidery, tailoring, weaving, patchwork, applique, handicraft, etc., and community managed agroforestry/forestry interventions can generate enough jobs for rural youths for year-round employment.

Organic farming is a way of life in most traditional rainfed farming landscapes in almost all agroecologies. Except for a few isolated pockets where purchased inputs are used to a limited extent, in about 80% arable land farmers are relying mostly on resources which are available locally for free (sunshine, saved seed, human and animal labor, animal waste, forest litter, compost, etc.). Linking organic farming with CSA initiatives, school meals (MDM), and value chain development will further enhance job opportunities for more sustainable farming and food systems.

In Indian agroecologies the land-holdings are very small and sometimes highly fragmented (e.g., hill agroecology), where land consolidation at individual farm HH level is not possible. Pooling the land and collective farming will be required for all proposed marketing initiatives. A pioneering attempt at developing farmer cooperatives performing various activities in agriculture, including input supply, is considered an absolute necessity. By and large, the experiences of performance of cooperatives in India has been poor, with a few exceptions of co-operative sugar factories and dairy cooperatives in Maharashtra and Gujarat states. In traditional agroecologies of India, however, it is hoped that farmer cooperatives can perform well for localized market-oriented farming

interventions. Women SHGs have been a quite successful experience in almost all these agroecologies.

Agro-ecotourism is one area where enough jobs can be created in agricultural landscapes at community level. The integration of tourism and agriculture activities will, therefore, open up a new horizon and can play the key role as new employment partners for rural communities, improving their economic status. Besides this, agro-ecotourism forms a potential alternative to routine tourism, which is farm-based and harmonious with nature.

Women self-help groups are a huge success in Indian agroecologies and contribute substantially to rural development, as also green jobs for rural men workforce in management of CPRs, agroforestry, and forestry management activities at community level.

Non-farm employment for rural youths at community level is therefore very vital to bring sustainability to agricultural production. Lanjouw and Shariff [33] assessed the contribution of non-farm sectors to household income across population quintiles. Analysis showed that non-farm income accounts for a significant proportion of household income in rural India, with considerable variation across quintiles and across India's major states.

The Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA) of India aims at enhancing livelihood security in rural areas, at community level, which has helped restrict out-migration of rural youth in search of petty off-farm employment elsewhere, but the scheme often fails due to misappropriation and subversion of funds in many states.

Political will and policy support for the above-stated marketing interventions will result in bringing sustainability to traditional farming and food systems. These interventions in combination with other suggested socio-cultural, environmental, and research interventions also needs due consideration for the sustainability of traditional farming. The issues are also being discussed here in brief in the subsequent section [1].

A food-based approach to community nutrition and health needs to be promoted [34]. Modern methods of food production no longer meet the health needs of the consumer; increasing reliance on industrial food production to meet our needs is not good for our health, or the health of our environment [34–37]. An econutrition model has been suggested for a healthy human nutrition that can be best achieved by an approach to agriculture that is biodiverse. New approaches have been explored, aimed at integrating environmental and human health, focusing especially on the many interactions between agriculture, ecology, and human nutrition [38,39].

The development of sustainable agriculture will require a more radical transformation of agriculture, 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.

One of the world's greatest challenges is to secure sufficient and healthy food for all, and to do so in an environmentally sustainable manner. Research strategies designed to co-deliver economic, environmental, and health goals will need to draw on inter-disciplinary collaborations to define priority research questions [40]. Food-based solutions to hunger, malnutrition, and poverty are of global concern and must be addressed if food and nutrition security is to be achieved in a sustainable manner [41].

Further, the governance of the global food system is seen to be challenged. Concerns have been raised regarding the exclusion of smallholders and poor countries from market opportunities derived from globalization. A transition to sustainability is necessary for a new management of food systems. Since food systems develop within a limited and sometimes shrinking resource base, they need to make use of natural resources in ways that are environmentally, economically, socially, and culturally sustainable to conserve the global ecosystem. Growth of food systems must be inclusive, must target objectives beyond production (including efficiencies along the food chains) and must promote sustainable practices and diets [36]. According to the HLPE [42], "A sustainable food system (SFS) is a food system that delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised".

FAO [43] pointed out that ending hunger requires that food consumption and production systems achieve more with fewer resources, which encompasses fostering sustainable intensification of food production, encouraging sustainable food consumption, and reducing food loss and waste. In order to understand which is the impact of the different factors on the food system, the Guidelines on Sustainability Assessment of Food and Agriculture (SAFA) Systems, elaborated by FAO, provide an international reference for sustainable management, monitoring, and reporting in food and agriculture at all levels of the supply chain. SAFA defines what sustainable food and agriculture systems are, including environmental integrity, economic resilience, social well-being, and good governance [44].

5. Conclusions

The farmers at all four distinct farming agroecologies of India were interested in selling their farm produce locally. Farmers were also willing to form cooperatives at the village level, pooling their land and undertaking collective farming, so that they produce enough surplus food for local marketing. Lack of well-developed local food markets so far have been the largest barriers to selling food locally for farmers. Farmers and most consumers are attracted to the CSA model and MDM programmes, seeking alternative ways to produce, consume, and communicate around food, where they are actively defining the agenda, with a focus on food and nutrition security. They want to bring forth fresh, safe, and locally produced food that is produced with care for environment, health, justice, and animal welfare. All farmer respondents were therefore in favour of a transition to more sustainable methods of farming. Selling the farm produce locally within their community helps both consumers and farmers alike. With a strong political will and policy support, transition to a well-developed localized marketing is therefore a big possibility. Local food systems have to become the norm, not a niche.

Formal expansion of organic farming in traditional production agroecologies and linking organic farming with the "localized" marketing interventions are likely to generate enough jobs at community level. Further, there are several other areas where job opportunities for the rural youths at their door step can be created. Among these, promoting agro-ecotourism, women-centric non-farm jobs through SHGs, and community agro-forestry/forestry management interventions are important. Traditional small-holder agriculture is generally considered "part-time". Increased feminization of agriculture in recent years, due to out-migration of the male workforce, combined with the forces of globalization, climate change, nutrition transition due to a cash-crop economy as a component of corporate agriculture, etc., have been negatively impacting the sustainability of the traditional biodiverse farming. The above-stated interventions will create enough jobs at community level for year-round engagement of rural youths and will ensure their availability for agricultural operations whenever needed.

Farmer cooperatives will have an important role to play in the proposed local food production and marketing interventions. The concerns of consumers will have to be placed center-stage, but those of the actual producers of the good food everyone desires are also considered equally important. Farmer cooperatives can fill an important niche in the local food movement and help raise public awareness of the challenges facing farmers across all these traditional small-holder agroecologies. It has been observed that the demand for local food far outstrips current levels of supply.

In all the traditional agroecologies the land-holdings are very small, sometimes highly fragmented, for example, hill and mountain agro-ecology, where land consolidation at individual farm HH level is not possible. Pooling the land and collective farming will therefore be required for proposed local level marketing initiatives. A pioneering attempt of developing farmer cooperatives performing various activities in agriculture, including input supply, is therefore an absolute necessity. In India, the co-operative movement in the past was initiated and established by the government and the experiences of the performance of cooperatives have been poor, with a few exceptions. Wide participation of people has been lacking. Therefore, the benefits of the co-operatives have still not reached many poorer sections. However, for local food movement the farmer

cooperatives will have a crucial role to play. We can learn a lesson from the success of women SHGs in all these agroecologies over the years.

In traditional small-holder Indian agriculture, nutrition transition is still very low. A better understanding of the relationships between food systems and human nutrition may, therefore, offer opportunities for improving nutrition that are currently overlooked. Whether such opportunities are captured will depend on possible trade-offs with the achievement of other development goals, as well as on policy goals and political factors.

The local food movement and more jobs for rural youths at community level for year-round employment will bring much needed transformation to traditional farming and food systems. It will make agriculture sustainable and will, in turn, lead to overall rural development.

A strong policy engagement is also needed in order to re-assess existing food and nutrition-related health and agriculture policy, and develop cross-sectoral implementation strategies on food and livelihood security, nutrition, and health.

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