

Sustainability of Rural Livelihoods through Technology Adoption: A case from Rudraprayag district, Uttarakhand, India

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Abstract - Most of the rural population of remote Himalayan region depends on agro-based activities for their livelihood, but most of them threatened by the problems of unemployment and food insecurity. Although, government has made many efforts to achieve self sufficiency in food production, the growth of the agriculture sector has been stagnant in this hilly region. The development of rain-fed areas, whose potentials have not been fully exploited so far, needs to be developed to address these problems. The present need of the area is to promote self-employment to enable the rural poor to earn sustainable livelihood, while enhancing food production by utilization of waste lands, water harvesting etc. There is essentially a need to develop production in rain-fed areas with integration of livestock, value added crops and agro-forestry. This paper is based on field experience from 12 villages of Rudraprayag district, Garhwal Himalaya.

Key Words: Livelihood, Technology, Sustainability, Farming, Composting

1. INTRODUCTION

India is one of the fastest growing economies in the world. But at the same time, the challenge before the country is how to ensure future growth in a sustainable and inclusive mode. It has various challenges in different nature in terms of employment, agriculture and rural development. Challenges have also been imposed by exclusive and inequitable access due to multiple deprivations of class, caste and gender. New technological approaches and solutions, and looking beyond the conventional mode of performing various tasks are required to solve these problems. New technologies could play a crucial role to ensure inclusion of vulnerable groups besides making the development environmentally sustainable.

The vast majority of farmers in developing countries are smallholders, with an estimated 85% of them farming less than two hectares [1]. These farmers mostly dependent on agro-based activities for their livelihood, but over 30 to 35% of them are threatened by the problems of unemployment and food insecurity. Hence, World Development Report (2008) emphasized that the potential of agriculture to

contribute to growth and poverty reduction depends on the productivity of smallholder farmers. And raising that productivity will require a much higher level of adoption of new agricultural practices and technologies than presently observed in the smallholder farming population [2,1].

The methods described in this paper have been developed from a basic understanding of the way that different assets and activities contribute to peoples' livelihoods. This understanding builds upon the livelihood approach to consider the functions of assets (such as land and livestock) and activities (such as agriculture and livestock husbandry) within people's livelihood strategies.

2. STUDY AREA

The area of the present study is district Rudraprayag of Uttarakhand. The study area is situated in the north western part of the Garhwal Himalaya. The district covering an area of 2439 km², which lies between the latitude 30⁰19' and 30⁰49' North and longitude 78⁰49' and 79⁰21' East. The region contains diverse vegetation types due to different altitudinal gradient, ranging from tropical deciduous to temperate and subalpine forest. Forest and water is the most important natural resources of the district.

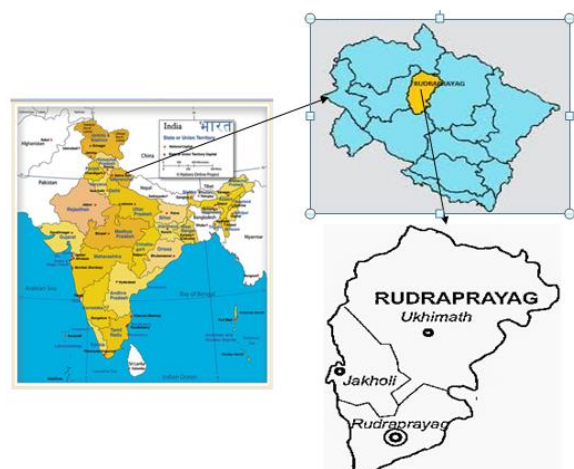


Figure-1: Map of the Study Area

3. DATA AND METHODOLOGY

The study has been conducted in the 12 villages of Rudraprayag district, Garhwal Himalaya, Uttarakhand and is based on the primary and secondary data. To select the sample households, random sampling procedure was followed. To begin with, 12 villages, namely Fatehpur, Narkota, Sumerpur, Ratura, Kandara, Kansil, Dhankurali, Nakot, Bhatwari, Kotgi, Mamni and Akhori were selected to represent different micro-climatic niches and cropping patterns. A sample of 120 households was selected randomly from these villages through proportional allocation method. The data on different aspects of agricultural development, livestock rearing and natural resource management specially water and land, were collected through personal interview and semi-structured questionnaire method during March 2014 to February 2015. The data were analysed using simple statistical tools like averages and percentages.

4. RESULT AND DISCUSSION

4.1 Rural Livelihood and its Sustainability

India has already established its leadership in different sector of information and communication technology and engineering but the present challenge is how to sustain the economic prosperity, particularly in remote rural areas. Therefore, rural development in the country requires priority because more than 65% of the population is still living in villages and over 85% of the rural people are dependent on agriculture for their livelihood [3]. In the study area, most of the farmers are small and marginal holders with small production only for 2-3 months self consumption. The over-exploitation of natural resources with the population growth affects the quality of rural life in the rural areas. Hence, it is necessary to develop a suitable strategy to improve the economy of the rural households through agricultural development and sustainable use of natural resources.

To achieve the goal of rural prosperity in this region, it is necessary that the development strategy should focus on improved agricultural production which provides gainful self-employment to the farmers. As agriculture and allied activities is the main source of rural employment, but being deprived of irrigation facilities, a majority of the small and marginal farmers are heavily under-employed for more than 6 months in a year in this region while now MGNREG scheme of government provide an alternative for short time. Even under well established irrigated conditions of the area, the growth of the agriculture sector itself has been almost stagnant from the last 15-20 years. Therefore, the policy makers and agriculture experts have been urging to accelerate growth in the agriculture sector.

4.2 Agriculture Enhancement Opportunities

While few farmers in the area continue to make efforts to increase agricultural production through adoption of new technologies and innovative inputs developed in the private sector, farmers in the rain-fed areas and backward regions will depend on the public sector research and development institutions to help them to improve agricultural productivity, with low investment in agricultural inputs. Hence, it is necessary to identify the target areas where there is good scope for improving agricultural production and its diversification. Approaches to this challenge include reducing the use of external inputs, increase the organic farming practices and integrating a wide range of low cost management technologies that build on services using natural resources.

The low external input and sustainable agriculture (LEISA) approaches involve limiting the use of external inputs such as inorganic fertilizers and pesticides and relying more on local and naturally available resources and a combination of traditional and improved methods to manage soil fertility, water, pests and other agronomic needs [4]. The particular methods used in the area include a wide range of technologies, such as water harvesting; agroforestry for soil and water conservation, the application of manure and organic fertilizer (Bio/Vermicompost), the incorporation of crop residues, the transfer of biomass and mulching, the use of leguminous cover crops, shrubs, or trees in improved fallows or intercropping systems.

Table - 1: New technology adoption by the farmers of surveyed villages

Innovation/technology adopted	Frequency of adoption*	Percentage
Organic farming (farmers used only manure or organic fertilizer)	87	72.5
Improved livestock breed	34	28.3
Water harvesting tank (all the structures supported by government)	07	05.8
Agroforestry (in last few years farmers starting plantation on agriculture fields bunds)	78	65.0
Bio/Vermicomposting (all supported by government)	15	12.5

*multiple response recorded

4.3 Organic Farming a Way to Enhance Rural Economy

The distinct geographical features of this Himalayan region, makes it a unique region to grow variety of fruits and other horticulture and cereal crops. The traditional farming practices of the region encourage use of manure or organic compost for agriculture as a way of life. Organic farming development in the region could have wide ranging ramifications in rural employment, ecological sustainability and remunerative agriculture. Organic agriculture is a specific type of low external input agriculture that adheres to certain principles in the production and transformation of agricultural commodities. Organic agriculture have the ability to improve the livelihoods of poor farmers in less-favoured areas. Either it is certified or non-certified.

Certified organic agriculture must meet certain standards in the production, processing and handling which developed in accordance with basic standards established by the International Federation of Organic Agriculture Movements [5]. Organic agriculture is based on minimizing the use of external inputs and avoiding the use of synthetic fertilizers and pesticides [6]. Based on certification, price premiums of 10 to 50 per cent are common for developing country exports of organic products [7,8]. Producers of organic products may also benefit from a more assured market than they may find for non-organic products. Organic farming has grown rapidly in the past few decades, and organic products are one of the most rapidly growing segments of the retail food industry. There are two types of organic farming in the region; one is part of the sustainable agriculture promoted by NGOs, and the second is promoted through government departments.

Table -2: Major crop grown under organic farming in the study area

Major crops cultivated	Organic Crops
Cereals	Fingermillet
	Barnyard millet
	Wheat
	Barley
	Amaranthus
Pulses	Black Gram
	Pea
	Lentil
	Horse Gram
	Pigeon Pea
Oil Seeds	Soybean
	Sesame
	Mustard

Organic farming is traditional method of farming in this hilly region of Uttarakhand but last few years villagers start using inorganic fertilizers in their fields mainly for the paddy and potato crops. But recently government of Uttarakhand banned the inorganic fertilizer in the district for promoting organic farming. The government officials (Horticulture & Agriculture Departments) aware the people about the benefits of organic farming and also provide them training and support for construction of compost pit. Thus, it is suggested that ample opportunities exist for the farmers to increase their income through production of organic crops. Now most of the small and marginal farmers grow organic and only few large farmers (about 3%) procure inorganic fertilizer (Urea & DAP) from outside as fertilizer depot is closed in the district.

4.4 Water Resource Utilisation

Water is an important input required to enhance agricultural production. The hilly region of Uttarakhand is deprived of irrigation facilities but the sustainable use of all the available water resources should be ensured to improve the crop

yields. In the absence of adequate water conservation measures, water scarcity is likely to be a serious bottleneck in the future. With increasing exploitation of natural resources and environmental pollution, the atmospheric temperature is expected to rise. If it happens, most of the rivers originating from the Himalayas may dry up and cause severe shortage of water for irrigation, suppressing agricultural production by 40-50% [3]. Rainfall is expected to be erratic and the water requirement for crops is likely to increase due to a significant increase in evaporation and transpiration losses. Therefore, greater awareness needs to be created to make efficient use of water resources and to prevent global warming through environmental protection. In the study area different type of water harvesting structure were observed such as polylined tank, ferro cement tank, simple tank etc., but these structures were present in very small number only 4 tanks were observed in all the 5 villages. And all the structure supported by government under MGNREGS and other schemes. Low adoption may be due to lack of awareness among the people about water harvesting and sustainable use of water resources and high construction cost as farmers are poor. There is a scope for introducing new technologies in the following areas for efficient management of water resources in the region:

1. Efficient harvesting and storage of rain water
2. Reducing loss of water by evaporation in reservoirs and tanks
3. Development of alternate and renewable sources of energy for rural uses
4. Technologies for low water consumption by crops and trees

4.5 Livestock Rearing

Livestock development is an important opportunity to provide gainful self-employment and food security for the rural poor households. The small and marginal farmers in the region, who do not have sufficient land for agriculture, are dependent on livestock for supplementary income. Small farmers consider livestock as an important asset for earning their livelihood, especially in this region where the huge demand of livestock and livestock products such as milk & milk products, meat, wool, manure, transport (Goods and human in remote area) etc., for various purposes. Therefore, livestock is well distributed among the weaker sections of the community compared to land. Promotion of dairy husbandry along with agri-horti-pasture, can generate remunerative employment for small farmers throughout the year. Probably, dairy husbandry is the only programme where poor families are able to build new assets every year in the form of crossbred cows, each worth over Rs. 25,000. There is also a need to strengthen veterinary health care through an extensive network of vets and para-vets to ensure good health, which has a direct impact on the cost of milk production and the quality of milk. In the study area almost all the household rearing livestock special cow and buffaloes ranging from 2-6 but the production is very low

with the traditional animals. Farmers now improve the breed through artificial insemination and about 42 percent of farmers rearing cross breed cow & buffaloes. Villagers of the surveyed villages complaint that the number of livestock were decreasing significantly during last 5-10 years. This may be due to lack of fodder resources, low production and over exploitation of fodder species from the nearby forest.

Following are the areas requiring new technologies to increase the productivity of the livestock industry in the area:

1. Genetic improvement for enhancing production and quality of livestock which in turns increase the income.
2. New technologies for increasing hygiene and sanitation in the cattle shed which decreases the intensity of disease.
3. Low cost animal health care using nuclear and light therapies in remote rural areas which provide resistance to livestock loss by disease.
4. Low cost cooling and processing of milk, meat and other food products which not only provides better income options to poor farmers but also reduce product loss.
5. Value addition for milk, meat and other products for better income.

4.6 Agro-forestry

Presently, a large part of the agriculture land in the region performs as waste land and are not being used for cultivating crop. In fact, farmers often incur losses by farming on such lands, due to natural calamities. These lands can be profitably used for establishment of drought tolerant fruit crops and agri-horti-pastures. As tree crops have the ability to withstand the vagaries of nature and also protecting the soil from erosion and runoff of rain water. Development of tree-based farming in these waste lands will enrich soil fertility on the one hand and increase the water table while absorbing atmospheric carbon dioxide round the year, on the other. With these benefits farmers can easily earn a net income of Rs.45,000 - Rs.60,000 per ha from crops like mango, cashew, custard apple, *amla* and tamarind once the orchards start bearing fruits [3]. Except foodgrains and vegetables, there are many plant species having food, medicinal and nutraceutical uses which can be planted as inter-crops to fetch good price even in local markets. Income from these crops can start from the first year and sustain the livelihood of the household. Horticulture development in these lands can also open opportunities for post-harvest processing which reduce the wastage and generate the additional employment in the rural areas. It is necessary to introduce new technologies for enhancing agricultural production on unproductive wastelands, which can help in proper diagnosis of various problems and develop suitable

solutions to address them. Some of the useful technologies/methods are:

Water Conservation for Irrigation:

1. Rain water harvesting and conservation through rain water harvesting tank, roof top harvesting, trenches etc. should provide a better option for enhancing irrigated area.
2. Sustainable utilization of water for irrigation by using drip and sprinkler irrigation and reduce the water requirement of crops by using poly mulching.
3. Use of proper technologies for improving the quality of land and irrigation water.

Crop Protection:

1. Improving crop yields and quality through genetic modification
2. Use of bio-compost, bio-fungicide, bio-pesticides, disinfectants
3. Drying and storage of seeds and food grains by using low cost techniques
4. Techniques for long shelf life of fruits, vegetables and other food products

Post-harvest Management:

Effective post harvest management of the produce should be possible by using following techniques:

1. Preservation of food by using safe techniques (chemical free)
2. Dehydration of fruits and vegetables through low cost techniques
3. Protection of natural colours and flavours in processed food

4.7 Skill development

For ensuring the agricultural prosperity in the rural Himalayan region, it is necessary to build the capabilities of the poor farmers through skill development/capacity building training programmes, particularly the women. Capacities of rural women has a direct influence on the agricultural production in the Himalayan region, as about 65-70% of the labour in crop production is contributed by women due to male migration for employment. Thus, it is necessary to build the capacities of poor farmers and provide them various essential services related to agriculture development by well-trained extension workers. It is also essential to re-build the infrastructure to address the anticipated technical problems and establish backward and forward linkages while launching various government agriculture development programmes. Presently, the agricultural extension services, input supply, credit and marketing facilities at the village level are extremely weak so there is an urgent need to strengthen these services in the region. We also need to create awareness among the poor about various government schemes and opportunities and

motivate them to take advantage of these opportunities for their socio-economic development. There is a need to tackle all the problems which affect the quality of life of rural poor and find solutions for betterment of rural poor.

5. CONCLUSIONS

Poverty and lack of employment is a serious problem in the study region, to overcome this situation it is a necessary to enhance agricultural production through promotion of organic farming as people gain more benefit from selling of organic produce, development of agro-forestry system on wastelands and livestock development through improving breed, particularly dairy husbandry with a special focus on generation of productive self-employment for the rural poor. These activities should enhance the economy of rural poor by providing them gainful self employment opportunity year around. The remote areas are also deprived of basic infrastructural facilities so they should be the target areas of current development programmes. There is also a need to develop low cost economically viable agriculture technologies as the target population is poor these technologies enhances the capacities of rural poor and enable them to take active part in the process of strengthening the regional economy.

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