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Challenges Endangering Economic Viability and Ecological Sustainability of Crop Diversification in Himachal Pradesh

Nisha Devi* and R.S. Prasher

Department of Social Sciences, Dr. Y.S Parmar University of Horticulture and Forestry, Nauni Solan 173230 (H.P), India

**Corresponding author*

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A B S T R A C T

The study was conducted in all the four zones of Himachal Pradesh with one representative district from each zone. All is, however, not well with the ongoing process of crop diversification in the state. Some impending challenges those endanger the economic viability and ecological sustainability of cash crops were lack of irrigation facilities, small land holding, fluctuating price, inadequate storage facilities, soil erosion, loss of water holding capacity, lack of processing facilities and lack of proper knowledge about the application of insecticides pesticides and fertilizers. The cultivation of high value crops, have started showing increasing symptoms of unsustainability due to, among other things, falling soil fertility, erratic weather conditions and the emergence of numerous insects, pests and diseases. The adoption of same cropping sequence year after year has caused the loss of micronutrients leading to deterioration in the overall soil health. The high incidence of diseases has led to an excessive use of agrochemicals that has given rise to a vicious cycle of falling productivity-more use of chemicals–further fall in productivity, and so on. This has not only escalated the production cost but has also affected environment and bio-diversity adversely.

Introduction

Agricultural transformation in a mountainous state like Himachal Pradesh is circumscribed by mountain specificities, namely, inaccessibility, fragility, marginality, niche and human adaptation mechanism created by unique vertical dimensions that distinguish them from plains (Jodha, 1992). While the first three specificities contribute in varying degrees, *inter alia*, to physical isolation, distance and high transportation costs and, therefore, create formidable constraints for agricultural transformation, the latter two suggests the availability of potential for growing a variety of micro niche based high value cash crops. The proliferation of extremely small and tiny holdings on account of factors like continuing population pressure on land coupled with general lack of rural non-farm employment opportunities, liberal laws of inheritance and resultant sub-division of holdings, etc. are the major constraints in boosting agricultural production and productivity and raising the levels of living of a typical Indian farmer. The problem is more

serious in mountainous states like Himachal Pradesh where only 13 per cent of the total geographical area is available for cultivation. There is a preponderance of tiny holdings in the state; about 88 per cent of the holdings are small and marginal owning less than two hectares of land and accounting for about 54 per cent of the operated area. The overall average size of holdings is 1.00 ha (Census of Himachal Pradesh, 2011). Therefore, improving the production and productivity of these tiny holdings and, in the ultimate analysis, the level of living of marginal and small farmers is a major challenge for the planners and policy makers. An acceptable and meaningful transformation will be expected to improve productivity, build resilience to farming systems, improve livelihoods and reduce harm to the environment.

Such critical practices and techniques include; crop diversification through rotations and intercropping, agroforestry, conservation tillage, cultivation of drought-resistant crops, water harvesting and integrated soil fertility management (Faures *et al.,* 2013). Truscott *et al.,* (2009) considers crop diversification an environmentally sound alternative to the control of parasites and in the maintenance of soil fertility in agriculture.

The crop diversification towards selective high value crops including fruits and vegetables, compatible with the comparative advantage of the region, is recommended as an effective strategy in raising incomes, generating employment opportunities and alleviating poverty among small and marginal households (Vyas, 1996; Joshi *et al.,* 2007). According to Njeru (2013) crop diversification not only allows more efficient utilization of agro ecological processes, but also provides diversity for human diet and improves income which improves the purchasing power for the household for buying other foods.

Materials and Methods

Data was collected from all the four agro-climatic zones of Himachal Pradesh for the agricultural year 2016. One district from each agro-climatic zone was selected purposively. Bilaspur (Shivalik Hill Zone), Solan (Mid Hill Zone), Kullu (High Hill Zone) and Kinnaur (Cold Dry Zone) districts was chosen for reasons of high significance and scope of introducing diversification activities into the farming systems of area. Two blocks from each selected district were purposively selected, one relatively highly diversified and one relatively least diversified in consultation with district level officers. For the selection of sample, three stage stratified random sampling design was adopted; with development block as a primary unit, village as a secondary unit and sampled farmer as an ultimate unit. Accordingly, 30 households were selected from each block thus making total sample size of 240 from four agro-climatic zones of Himachal Pradesh. Garrett's Ranking Technique was used to prioritize the imminent challenges/constraints.

Garrett's ranking technique

Per cent Position= 100 (Rij -0.50)/ Nij

Where,

Rij = Rank given to the ith item by the jth individual,

Nij = Number of items ranked by the jth individual,

The per cent position of each rank was converted into scores using Garrett's table. For each constraint score of the individual respondent were added. Thus, mean score for each constraint was ranked by assigning higher rank (1) to highest value Garrett mean score.

Results and Discussion

Economic viability and ecological sustainability

Agriculture is one of the sectors significantly affected by climate change and variability. Seasonality dynamics, increased frequency of droughts (especially mid-season dry spells), increased temperatures, altered patterns of precipitation and intensity are some of the extreme weather events. Declining crop yields, increased agricultural risks, diminishing soil fertility and environmental degradation are some of the main challenges which continue to threaten societal goals of improving food, income and nutrition security especially in smallholder farming. It, therefore, calls for a significant transformation in agriculture to withstand the emerging challenges (Tewari *et al.,* 1992).

Farm profitability from crops were considered to be the indicator of economic viability. Farm productivity was measured through physical yield of crops and crop yield data were collected through a household survey. Farm profitability was then determined based on financial return per unit of land and the financial return was analyzed through Benefit-Cost ratio. It was considered that if the benefit-cost ratio found greater than 1 then that crop is economically viable in that area. All the high value crops were found viable in all the four agroclimatic zones of Himachal Pradesh.

Constraints/ Challenges

High value crops like fruits, vegetables and flowers are confronted with numerous constraints due to their highly perishable nature, high-tech requirements, costly planting material/seeds, inputs, etc. Thus, for encouraging the production and efficient marketing of these crops, various problems and constraints in their production and marketing with which they are confronted with, are needed to be identified.

Production constraints

In production constraints at overall level lack of irrigation facilities was the major problem found in the study area (Table 1). This was the major problem with highest rank in Zone-I, Zone-II and Zone-III. It was expected that the unreliable rainwater would impose severe limitations on the agricultural production. Unreliable rainfall is a major constraint in the diversification of agriculture. While in Zone-IV small land holding was the major problem. It was also highly severe problems at state level. There is a preponderance of small land holdings in Himachal Pradesh. According to Agricultural Census of Himachal Pradesh (2010-11), small and marginal farmers together constitute 88% of the total population of the state. The average size of holding was 1.0 hectares in 2010-11. Fluctuating production, unfertile holding and cash shortage when needed also contributed to production constraints. Problems like non-availability of skilled labour at operation period, costly labour, non-availability of quality seed and planting material, fertilizer and Plant protection chemicals not available in time were also observed. India lacks modernized infrastructure for promoting the agriculture sector. Rudimentary policies and old fashioned equipment's and practices used by farmers in India are not sustainable, resulting in low productivity for many agricultural commodities (Dwivedy, 2011).

Marketing constraints

Agri-commodity sector is still lacking in a well-developed, organised and integrated market for spot trading of commodities. Farmers quite often are faced with a risk of what to grow and when and where to sell.

Table.1 Production constraints being faced by the farmers

Constraints	Zone-I (Bilaspur)		Zone-II (Solan)		Zone-III (Kullu)		Zone-IV (Kinnaur)		Over all	
	GMS*	Rank	GMS*	Rank	GMS*	Rank	GMS*	Rank	GMS*	Rank
Small land holding	72.78	V	70.63	V	76.18	II	77.00	I	74.15	II
Cash shortage when needed	76.33	IV	73.72	III	64.75	VIII	67.48	VIII	70.57	V
Fertilizer and Plant protection chemicals not available in time	62.12	VIII	63.60	VIII	65.93	VII	67.58	VII	64.81	IX
Un-fertile holding	78.33	II	72.17	IV	65.97	VI	68.50	VI	71.24	IV
Costly labour	68.20	VI	67.73	VII	70.02	V	70.47	V	69.11	VII
Non-availability of skilled labour at operation period	64.13	VII	69.45	VI	75.58	III	72.40	IV	70.39	VI
Fluctuating production	76.37	III	76.95	II	75.40	IV	64.75	IX	73.37	III
Lack of irrigation facilities	81.00	I	78.00	I	79.13	I	76.50	II	78.66	I
Non-availability of quality seed and planting material	61.90	IX	62.87	IX	64.00	IX	73.68	III	65.61	VIII

Table.2 Marketing constraints being faced by the farmers

Constraints	Zone-I (Bilaspur)		Zone-II (Solan)		Zone-III (Kullu)		Zone-IV (Kinnaur)		Over all	
	GMS*	Rank	GMS*	Rank	GMS*	Rank	GMS*	Rank	GMS*	Rank
Non-availability of institutional credit	55.03	VIII	57.93	VIII	68.12	VI	66.50	V	61.89	VII
High transport charges and lack of all-weather roads	65.93	III	66.73	III	71.17	III	66.73	IV	67.64	III
Distant markets	73.90	II	68.53	II	76.00	II	69.58	II	67.83	II
Lack of vehicles and non-availability in time	52.13	VII	52.63	VII	64.75	VII	55.92	VIII	56.36	VIII
Fluctuating price	74.10	I	72.55	I	77.20	I	73.25	I	74.28	I
Inadequate storage facilities	65.25	V	62.98	VI	68.20	V	68.57	III	66.25	V
Malpractices by traders at the time of auction	65.62	IV	65.25	IV	68.23	IV	66.23	VI	66.33	IV
Lack of market intelligence	61.53	VI	64.20	V	58.63	VIII	63.50	VII	66.14	VI

*GMS-Garret mean score

Table.3 Ecological challenges related to farming being faced by the sampled farmers

Constraints	Zone-I (Bilaspur)		Zone-II (Solan)		Zone-III (Kullu)		Zone-IV (Kinnaur)		Over all	
	GMS*	Rank	GMS*	Rank	GMS*	Rank	GMS*	Rank	GMS*	Rank
Loss of soil fertility	65.20	III	63.92	III	69.47	VI	63.92	III	65.63	III
Soil erosion	62.82	IV	62.63	V	74.38	IV	62.63	V	65.62	IV
Loss of water holding capacity	62.57	V	60.72	VII	74.30	III	60.72	VII	64.58	V
Loss of genetic diversity of planting material	58.72	VIII	61.42	VI	70.97	V	61.42	VI	63.13	VII
Soil contamination with chemical fertilizers, pesticides and others	59.72	VII	63.10	IV	67.92	VII	63.10	IV	63.46	VI
Incidence of diseases and insect pests attack	71.50	II	67.65	I	76.80	II	67.65	I	70.90	II
Water related problems										
a) Availability of water resources	73.60	I	66.33	II	77.80	I	66.33	II	71.02	I
b) Irrigation water quality	52.60	IX	54.10	IX	57.65	IX	54.10	IX	54.61	IX
Loss of soil organisms/ predator	61.03	VI	59.05	VIII	61.77	VIII	59.05	VIII	60.22	VIII

Table.4 Other constraints related to farming being faced by the farmers in the study area

Constraints	Zone-I (Bilaspur)		Zone-II (Solan)		Zone-III (Kullu)		Zone-IV (Kinnaur)		Over all	
	GMS*	Rank	GMS*	Rank	GMS*	Rank	GMS*	Rank	GMS*	Rank
Irregular monsoon	79.60	I	79.85	II	79.00	I	62.50	VII	75.24	V
Less experience in the field	61.13	IX	59.98	IX	58.90	IX	58.00	VIII	59.50	IX
Costly planting material	77.77	V	75.50	IV	69.73	VII	82.00	I	76.25	III
No local processing facilities	78.60	III	73.50	VII	78.60	II	80.00	II	77.67	I
Large initial investment needed	78.53	IV	73.30	VIII	72.33	VI	70.45	V	73.65	VI
Lack of policy support	71.72	VIII	75.13	VI	69.43	VIII	65.92	VI	70.55	VIII
Wild animals menace	78.80	II	81.40	I	78.60	III	50.53	IX	72.33	VII
Unreliable sources of seed/ planting material	77.33	VI	75.27	V	75.00	V	77.40	IV	76.25	IV
Lack of proper knowledge about the application of insecticides, pesticides and fertilizers	72.8	VII	76.73	III	77.60	IV	78.00	III	76.28	II

GMS*- Garret Mean Score

Any development in this front will directly facilitate the growth of the commodity futures markets also on those agri products. The agricultural products prices are highly volatile. A farmer is highly susceptible to price fluctuations both of farm produces and farm inputs (Kumar, 1991, Negi *et al.*, 1997).

Price fluctuation is a multifaceted problem attributed by various factors which, when combined, culminate in dangerous consequences for the most vulnerable. Although high prices can technically be good news for farmers, price fluctuation is extremely dangerous, as farmers and other agents in the food chain risk losing their investments if prices fall. This severe marketing constraint was noticed during the survey in all the zones and is thus, ranked first (Table 2). Distant markets are playing their role in proving a constraint for diversification in agriculture and are hence, ranked second. High transport charges and lack of all-weather roads, malpractices by traders at the time of auction and inadequate storage facilities were another highly severe problems related to marketing which were ranked 3rd, 4th and 5th respectively at state level in the study area. Traditional harvesting and storage conditions of Indian farms and farmers result in large proportions of crop wastage. It has been estimated that crop wastage due to inefficient storage is 7 per cent of annual grain production per year in India. This percentage accounts for 21 million tonnes of wheat grain alone, as India lacks proper cold storage and cold chain transportation (Suprem *et al.*, 2013).

Ecological constraints

The farming community is facing several threats due to environmental changes and pollution. Crop damages due to climatic changes are putting a lot of pressure on the farmers. The cultivation of high value crops, especially horticultural crops, has started showing increasing symptoms of unsustainability due to, among other things, falling soil fertility, erratic weather conditions and the emergence of numerous insects, pests and diseases. The adoption of same cropping sequence year after year has caused the loss of micronutrients leading to deterioration in the overall soil health. Land use pattern in the state of Himachal Pradesh in the Indian Western Himalayas has been undergoing rapid modifications due to changing cropping patterns, rising anthropogenic pressure on forests and climate changes. Sharma (2011) reported that the emerging challenges like rapid depletion of soil fertility, changing weather and climatic conditions, increasing erosion of comparative advantages, increasing competition from cheaper imports, inadequate infrastructural facilities and old age of crop bearing apple plantations pose a serious threat to the economic viability and ecological sustainability of the process of crop diversification in Himachal Pradesh. In the study area availability of water resources showed a deep impact in all the zones (Table 3). However at state level problem of availability of water resources was ranked first and incidence of diseases and insect pests attack was ranked second. There has been an ever increasing pressure on the natural resources due to the rising population. Loss of soil fertility, soil erosion, loss of water holding capacity, soil contamination with chemical fertilizers, pesticides and others, loss of genetic diversity of planting material, loss of soil organisms/ predators were the other problems which were ranked 3rd 4th, 5th, 6^{th,} 7th and 8th respectively.

Other challenges

Consumption of processed products started since time immemorial. The production was mainly for private household consumption and commercial production started very late.

The processing facilities were very much limited. Absence of cold storage for storing agriculture produce was major problem in the study area (Table 4). Lack of proper knowledge about the application of insecticides pesticides and fertilizers was the second most important constraint at overall level. The farmers know little to nothing about the pesticides they use. They are solely reliant on information from input dealers. Approved uses, correct doses and waiting periods are not mentioned on the labels of pesticides bottles or packets. The labels state that the leaflet given along with the pesticide must be consulted before use; however, most of the farmers ignored the same. Costly planting material, unreliable sources of seed/ planting material, irregular monsoon, large initial investment needed, wild animals menace, lack of policy support and less experience in the field which were ranked in their ascending order from 3 to 9 respectively in Himachal Pradesh. Lack of availability/adoption of advanced technology suitable for hill agriculture is one of the main constraints in crop diversification in the state of Arunachal Pradesh (Mishra, 2006). The transition towards high-value agriculture is not without constraints, especially for smallholders. If the high-value commodities are products that the farmers have not grown before, the farmers may lack necessary information on production methods, marketing opportunities, and the probable distribution of net returns. This problem is particularly acute when the target consumers have very specific quality requirements and/or strict food safety requirements (Minot and Roy, 2006).

The diversification of hill agriculture can provide better choices and quality options for sustaining the livelihoods of hill farmers but what is necessary in this process is to develop a clear understanding of the ecologically and economically sustainable farming options. Highly severe constraints related to production were lack of irrigation facilities and small land holdings. In the marketing of fruits and vegetables in Himachal Pradesh fluctuating price was observed as major constraint. Distant markets, high transport charges and lack of all-weather roads were other highly severe problems. Major ecological constraints were problems in availability of water resources and incidence of diseases and insect pests attack. The emerging challenges like lack of proper knowledge about the application of insecticides pesticides and fertilizers, rapid depletion of soil fertility, changing weather and climatic conditions, increasing erosion of comparative advantages, increasing competition from cheaper imports, inadequate infrastructural facilities and old age of crop bearing apple plantations pose a serious threat to the economic viability and ecological sustainability of the process of crop diversification in the state.

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