Enhancing production and income

through technological interventions under changing climatic scenario

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This article describes the importance of the National Mission for Sustaining Himalayan Ecosystem (NMSHE) project in the Indian Himalayan region under changing climatic scenario.

Keywords: Climate change, Technological intervention, Crop diversification, Polyotank

SHRI Har Singh, is an Ex-army person and a farmer from Hawalbagh Block of Almora district of Uttarakhand. After retirement, he adopted farming as a profession. He had farm area of 0.28 ha and three cow, and had been practising the cultivation of cereal based cropping system (finger millet + horse gram – wheat + mustard) for years which was not enough to provide him with the returns to meet his family needs all round the year. With the cereal based system, he could fetch only a net return of ₹ 4,93,744 from cropping system with B:C ratio as 2.99. About 10-12 years ago, he switched over to grow vegetables like garden pea and transplanted paddy, which used to provide a high return. But climate change created hurdles in the sustenance of the system. There was shortage of water for irrigation to the crop and fodder for animals. As a result, the farmer confined his farming to cereals, millets and some pulses that too in *Kharif* season only. *Rabi* crops, especially wheat, failed due to erratic rainfall and lack of irrigation. Drought was noted in every alternate year. Further, the condition deteriorated due to lack of awareness among farmers and poor access to improved crop varieties. Har Singh's son, Shri Bhagwat Singh, was also seeking some alternate livelihood and thus was prepared to migrate from the village to a nearby city in search of job as farming no longer seem profitable to him. Other farmers of the village also share the similar story and almost one male person from each village in the region migrated to big cities like Delhi, Dehradun and upto Chennai to find work in Hotel or some other industry.

Shri Har Singh was aware of climate change and its effect on agriculture but was not aware of the technological interventions that can be adopted in agriculture to inaligate climate change. His ways of passive adaptations were not adequate to alleviate or lessen the climate change effects in agriculture. In the emerging situation, ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora came to the rescue of the farmer. Believing that a combination of strategies would be more effective than a single strategy in adaptation to climate change vulnerability, the institute selected few scalable strategies and technologies for adoption in his field to enhance his income and production against the vagaries of climate change. The institute motivated him for integrated farming comprising demonstrations on improved varieties of crops including vegetables and natural resources management.

Technological interventions and their impact

The farmer was adopted under the *National Mission for Sustaining Himalayan Ecosystem* (NMSHE) programme and was provided technical guidance to diversify his cropping system with the cultivation of diversified vegetables to reduce the risk of heavy dependence on monocropping besides generating year round income. Improved short duration varieties of crops were introduced for higher yields and reduce climate change impact. For this, firstly water was conserved in his field through construction of low-cost long-life hybrid (poly-cement) tank and subsequently, drip irrigation was introduced. In addition to above, the farmer was advised to cultivate azolla for reducing the feed cost and ensuring proper nutrition to cattle, poultry, fish and also to be used as biofertilizer.

The integration of the various interventions started bearing fruits. The motivational interventions and mentoring by scientists of the NMSHE programme team enabled the farmer to adopt new crops in his conventional cropping system which has not only resulted in

Fig. 1. Photographs (a-h) shows the various farming system activities adopted by Shri Har Singh (a) Soil health card, (b) Fish cultivation, (c) Azolla cultivation, (d) Water conservation, (e-h) Barley, soybean, vegetable and barnyard cultivation.

socioeconomic security but also helping in attaining household food and nutrition security. The deliberations during one of the farmers' meeting organised by the ICAR-VPKAS along with ICAR-IISWC and other partners from different institute, the farmer, Har Singh, was motivated to construct three poly-lined tanks of 73.6 m^3 capacity in his field having irrigation potential of 3,000 m^2 area. He was probably the first farmer who took initiative of making polytank in his field (Fig. 1). As a result, the field nearby his house which was entirely rainfed is now 100% irrigated. The construction cost of the three tanks was ₹ 74,000. Among the three tanks, one of the tanks constructed on 10 m^2 area is being used for growing azolla and in one month, 20 kg green azolla is being harvested which is being used as cattle, fish and poultry feed.

Table 1. Area, production and productivity of crops before and after launching of NMSHE

Crops	Area (ha)			Production (q)			Productivity (q/ha)		
	Before	After	Change (%)	Before	After	% change	Before	After	% change
Kharif Crop									
Barnyard millet	0.1	0.03	-70	2	0.75	-62.5	20	25	25.0
Finger millet	0.05	0.02	-60	1.7	0.8	-52.94	34	40	17.6
Maize	0.01	0.02	100	0.6	1.25	108.33	60	62.5	4.2
Soybean	0.03	0.11	266.7	0.65	3.85	492.31	21.7	35	61.5
Horsegram	0.02	0.07	250	0.45	1.75	288.88	22.5	25	11.1
Chilly	0.01	0.01	-	0.5	0.5	-	50	50	-
Coriander	0.01	0.02	100	0.4	0.8	100	40	40	-
Garden pea	0	0.002	-	0	0.12	-	0	60	-
Rabi Crop									
Wheat	0.1	0.1	-	2	2.5	25.0	20.00	25.0	25.0
Lentil	0.03	0.04	33.3	0.4	0.6	50.0	13.33	15	12.5
Potato	0.02	0.06	200.0	1.5	4.5	200.0	75.00	75	0.0
Onion	0.01	0.03	200.0	0.8	2.5	212.5	80.00	83.3	4.2
Lahi	0.05	0.05	-	1.0	1.0	-	20.00	20	-
Capsicum	0	0.00017	-	0	0.0204	-	-	120	-
Tomato	0	0.00032	-	0	0.08	-	-	250	-

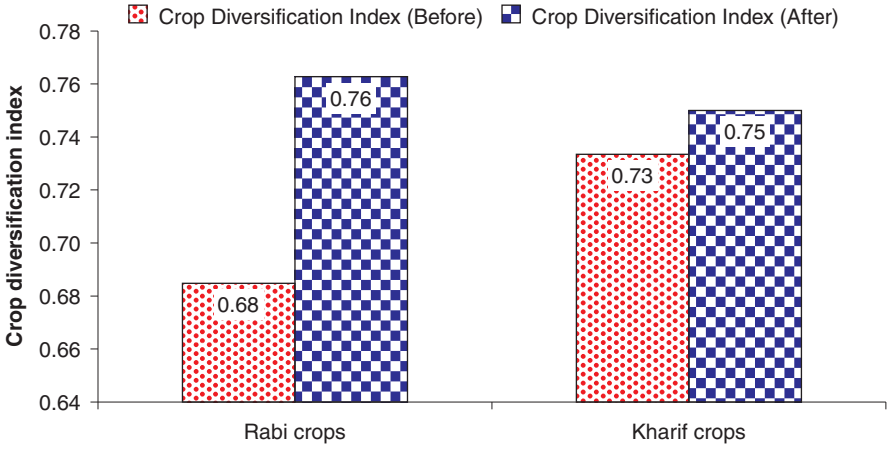

Fig. 2. Impact of interventions on Crop diversification

The crop diversification index increased in *Rabi* season by ensuring irrigation through spring water harvesting. Before the intervention farmer had limited crop cultivation in *Rabi* crops due to insufficient / lack of winter rains which affected crops adversely and often resulted in crop failure (Fig. 2).

Shri Har Singh also recycles farm waste into healthy manure through the vermin-compost unit of 4.5 m^3 which can yield 20 quintal compost

Table 2. Cost of production, gross returns and net returns of farmer per annum (before and after the interventions)

Crops	Cost of cultivation (₹)		Gross returns (₹)		Net returns (₹)		B: C Ratio	
	Before	After	Before	After	Before	After	Before	After
Kharif Crops								
Barnyard millet	3,309	1,122	3,780	2,363	471	1,241	1.14	2.11
Finger millet	1,559	682	2,205	2,520	646	1,838	1.41	3.69
Maize	484	1,020	1,056	2,200	573	1,180	2.18	2.16
Soybean	1,089	4,603	2,250	19,250	1,162	14,647	2.07	4.18
Horse gram	759	3,023	4,500	17,500	3,741	14,477	5.93	5.79
Chilly	587	586	5,000	5,000	4,413	4,414	8.52	8.53
Coriander	456	922	4,000	8,000	3,545	7,078	8.78	8.67
Capsicum	-	12	-	82	-	70	-	6.83
Tomato	-	24	-	160	-	136	-	6.78
Rabi Crops								
Wheat	4,278	4,340	2,760	4,600	-1,518	260	0.65	1.06
Lentil	1,583	1,810	1,790	2,685	207	656	1.13	1.48
Potato	3,082	6,558	3,750	11,250	668	1,564	1.22	1.72
Onion	776	1,216	1,600	5,000	824	1,261	2.06	4.11
Lahi	1,230	1,386	4,200	5,460	2,970	4,074	3.41	3.94
Pea	-	235	-	420	-	185	-	1.79
Total	19,189	27,540	36,891	86,489	17,702	53,080	3.21	4.19

per year with a value of ₹ 6,000. He has also established a poly-cum-shed house, for off-season vegetable production. The low-cost poly-cum-shed net house is constructed in 75.6 m^2 area with an investment of ₹ 21,000 only. He is fetching ₹ 16,144 net income from vegetables under poly-cum-net house. Hence, the pay-back period of poly-cum-net house construction is 1.5 years. He also grown fruits as new crops namely walnut (8 plants), malta (4 plants), orange (3 plants), peach (10 plants), plum (2 plants), nectrin (2 plants) and kiwi (2 plants), which will bear fruits in coming years. He has installed a honeybee box for better pollination and fruiting in crops. He has also introduced a local breed of poultry birds in his farm (Table 1).

Earlier Shri Har Singh used to practise farming in 0.21 ha area in *Rabi* and 0.23 ha area in *Kharif*. In general, the productivity of almost all the crops was very low compared to the state average. After the intervention, he has increased his cropping area to 0.28 ha in both seasons. The percentage change in the area, production and productivity of crops due to interventions is given in Table 1.

The adoption of innovative technologies through the intervention of ICAR-VPKAS, Almora, in form of improved high yielding crop varieties, polytanks and poly-cum-shed house enhanced area under crops in his fields with higher productivity and production. Earlier, the farmer was getting only ₹ 36,891 per annum of gross returns and ₹ 17.702 per annum of net returns from his crops. After the interventions under the NMSHE programme, the gross returns and net returns were ₹ 86,489 and ₹ 53,080 per annum, respectively. There has been an additional gross return and net returns of ₹ 49,598 annum (i.e. 2.3 times increase) and ₹ 39,352 annum (3 times increase) in a small land size of 0.28 ha with a meagre increase in cost by ₹ 8,351 annum. The cost benefit ratio was increased from 3.21 before intervention to 4.19 after the intervention. The main factors that have contributed to his success are his interest in and passion towards advanced technologies (Table 1).

Way forward

Shri Har Singh is now a role model for other farmers. The technical support from helped him to shore up and integrate his farming through the introduction of improved varieties / hybrids of field and vegetable crops, azolla as cattle, fish and poultry feed, vermin-compost, poultry, fodder and drudgery reduction through farm mechanisation. The immediate social impact one could see is the purchase of 4-wheeler by the stakeholder in a short span of four years. The success of the technological interventions also generated interest in his son for farming and he has taken up farming as his livelihood option instead of leaving the village for a petty job. The story of Shri Har Singh, who increased his income by adopting different technological interventions could well be the right signal for hill farmers of Uttarakhand facing the scenario of low yield and income coupled with unpredictable rainfall.

Feedback

I am happy now because I am earning more money by adapting technological interventions. It gave

me higher production of grain, vegetable, fodder and honey. Besides, I can stay with my family and give them fresh and nutritious food. The change in my village after the start of the NMSHE programme would compel other migrated villagers to give a second thought.

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