Himachal Journal of Agricultural Research 42(2): 101-114 (2016)

Doubling farmers' income: A model for hilly and mountainous region

Ashok Kumar Sarial*
CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur-176 062, India.
Corresponding author : vc@hillagric.ac.in

Received: 20 January 2017; Accepted: 24 June 2017

Abstract

The growth and development of agricultural sector has a strong linkage with other sectors and a striking effect on poverty and unemployment alleviation problems. Agricultural household activities comprise of crop sector (field crops and horticulture), livestock sector (dairy, poultry, piggery, small ruminants), farm linked activities (mushroom, beekeeping, sericulture) and post production activities (off-farm enterprises). This paper explores the avenues and possibility of doubling farmers' income by 2022 in the state of Himachal Pradesh as envisioned by Hon'ble Prime Minister of India. Obviously the objective of doubling the income can be achieved through all round development of farm, off-farm and non-farm avenues in the rural areas. The paper highlights these options through use of technology to increase the productivity of crops in a sustainable way, giving due emphasis to ancillary enterprises, agro-processing and institutional/market support with the concept of maximum sale price than minimum support price. The income potential of different activities/enterprises has been estimated along with strategies to harness the potential.

Key words: Doubling farmers' income, cropping systems, ancillary enterprises, value addition, cost and net returns, remunerative pricing, action plan.

During the run up to the Green Revolution in India and thereafter, the emphasis was always on production and productivity. Many schemes in agriculture during the five-year planning cycles, generally aimed at enhancing production and productivity. The Government policies were usually farm-centric and not farmer-centric. This is one of the reasons why there is farmers' distress despite the fact our country has achieved commendable position in food grain production. Being a predominant sector of the economy, the growth of this sector has a strong linkage with other sectors and a striking effect on poverty and unemployment. It has also been pointed out that per capita income in agricultural sector was just one third of the per capita income in the country thereby creating a huge income disparity between primary agriculture vis-à-vis other sectors of economy. The gap has been continuously widened showing alarming unrest among farming community across different states. National Sample Survey Office (70th round) data also revealed that 53 per cent of farm households earn income lesser than poverty level income and 52 per cent of the farmers in the country were indebted, majority of whom were marginal farmers and agricultural labourers. The studies have shown that farm sector faces the proverbial 'paradox of poverty in plenty' in the absence of efficient supply chains and value realization. The low prices for the good harvests in contrast to high prices during the low harvests keep the farmers almost at the same level of income.

The Hon'ble Prime Minister of India, Sh. Narendra Modi, while addressing a farmers' rally at Bareilly in Uttar Pradesh on February 28, 2016 expressed the government's resolve to double farmers' income by 2022. Announcing the target of doubling famers' income by 2022, the Hon'ble Finance Minister in his Union Budget Speech 2016-17, also highlighted the need to think beyond 'Food Security' of the country to focus on 'Income Security' of the farmers. This has also evoked interest among a variety of stakeholders-farming community, scientists, economists, political commentators, besides the general public. For achieving this objective, we will have to devise micro and macro -level action plans to augment farmers' income from all sources and not just from crop cultivation. The NSSO (70th round) data reveal that average monthly income per agricultural household in India during the agricultural year 2012-13 was estimated at Rs. 6,426 in which net receipt from farm business (cultivation and farming of animals) accounted for 60% of the average monthly income and the income from wages and salary accounted for a sizeable proportion of nearly 32%. Thus, the goal of doubling the income of the farmers by 2022 cannot be achieved by raising production alone unless the integrated approach is followed and necessary backward and forward support

* Vice-Chancellor, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur-176 062

services are strengthened in the rural area. Keeping this in view, this study will be a timely endeavor to suggest strategies and to serve the avowed objective of doubling farmers' income by 2022. An attempt has been made in this paper to explore the opportunities for enhancing farmers' income in the north-western Himalayan region in general and in the hilly and mountainous state of Himachal Pradesh in particular.

Agriculture and economy of Himachal Pradesh

The economy of Himachal Pradesh is based upon agriculture, horticulture, animal husbandry, forest, cottage industries, tourism, hydropower generation and mineral wealth. Hill economy is mainly agro-pastoral and basically rural with more than 92 per cent of the population living in villages depending directly or indirectly on agriculture and allied activities. However, the share of agriculture has been declining continuously and there has been no major decrease in working population which is certainly not a healthy sign for the development of large chunk of population living in rural areas.

The dominant features of farming in Himachal Pradesh are small and fragmented land holdings, undulating topography and cultivation under rainfed conditions as only 19 per cent of the cultivated area is irrigated. Thus , majority of the farmers in the state remain engaged in traditional cultivation of food grains not being able to divert to more profitable commodities such as vegetables and fruits. However, the state harbours several 'niche' situations with potential comparative advantages over plains in terms of producing certain commodities like temperate fruits and off-season vegetables that either can only be produced in hills or these are produced at a time and place when not available in other parts of the country. Therefore, it is important to increase the productivity of the existing cultivated area through shifting from self subsistence to diversified agriculture, by adopting high value cash crops in hilly and highland areas. Being hilly region, most of the geographical area of the state (around 81 %) is under forest and pasture resources that can be regarded as the strength of the state for expanding forest and pasture based avocations like forest based industries, preservation and harnessing medicinal and aromatic plants and rangeland livestock farming. The cultivated area accounted only for about 11 per cent of the reported area in 2009-10 which is the most limiting factor for agricultural development. There is also increase in the land put under non-agricultural uses like roads, buildings, water reservoirs, etc, due to ever increasing needs of infrastructure and over-head facilities for economic development in the state.

Cultivation of crops is a major source of family income of 38.7 % of households in Himachal Pradesh as compared to 63.5 % in India (Table 1). In hill state of Himachal Pradesh 40.7 % households depends on cultivation of crops, livestock rearing and other non-agricultural activities to earn income for their families. Farming in the state is characterized by small and fragmented holdings and high dependence on monsoon rains. Operating small holdings is often unviable and farming is not a profitable business or enterprise. It is an occupation in a sector marked by large-scale unending uncertainties at every stage of farm operations.

As per 2013 estimates total monthly income of farmers in Himachal Pradesh from all sources was Rs. 8777 compared to Rs.6653 at national level. Of the total Rs.8777 wages contributed Rs. 4030, cultivation Rs. 2876, farming of animals Rs. 1047 and non-farm business Rs. 824 (Table 2). Hence, to double the income earning from these components/activities has to be doubled.

Scope for enhancing farmers' income

Farmers' income can be improved when productivity goes up; the cost of production comes down and remunerative price is ensured through a transparent price discovery mechanism. It can also be supplemented through improved earnings from allied activities to agriculture and non-farm sector or even through wage employment. In order to double farmers' income, there is a need to increase farm productivity through efficient use of inputs/resources, improve market efficiency and also to strengthen allied industries and off-farm avenues/services. It needs to be mentioned that farm income flows, both in absolute and relative terms, are intermittent and inadequate for supporting livelihood of farm households the year round. Because of this, agrarian distress is not limited to rainfed areas and has also spread to progressive farming situations too. The possible growth drivers of farmer's income are- crop cultivation, horticulture, dairy, poultry, fisheries, other allied activities, non-farm activities, remunerative prices and wage employment. During the last 30 years, the income disparity between farm and non-farm households has increased. In 1983–84, the average income of a farm household

used to be about one-third of that of a non-farm household. By the year 2004-05, this figure had reduced to one-fourth. There was some improvement during the subsequent period, up to 2013-14, due to some improvement in agricultural growth.

Researchers have observed that agricultural income in real terms including the effect of transfer of technology (TOT) doubled in 7 years between 2006-07 and 2013-14 in states like Gujarat, Jharkhand, Madhya Pradesh, Rajasthan and Telangana. By 2022, most of the states are in the process of transition towards doubling farmers' income (Sharma 2017).

Strategies for Doubling Farmers' Incomes in hilly and mountainous state of Himachal Pradesh

For doubling income, rather than focusing on doubling output, a plan that puts in place the right combination of measures that will work for the particular growing situation, needs to be worked out. Some of the key strategies are discussed below.

1. Increasing crop yield

Increase in yield or productivity of crops and other enterprises is the most important factor that can increase income. Since the area cannot expand much, either through increase in net sown area or through increase in cropping intensity, enhancing the productivity is the only route available to enhance production. While varietal improvement through conventional breeding or biotechnology is a long term option, bridging yield gaps through adoption of recommended agronomic practices, planning profitable crop-mix that can maximize aggregate income, and reducing crop losses through integrated pest management are short/ medium term options that can bring in additional income. If income from cultivation to be doubled to Rs. 5752 from existing Rs. 2876 per month per household then the average productivity of the cereals from the present 1.35 t/ha has to be raised to 3.0 t/ha. Currently productivity of cereals under irrigated cropping system is 3.0 t/ha while under non- irrigated system it is about 1.0t/ha. Himachal state has 5.40 lakh ha area under cultivation which is just 10 % of the total 55.67 lakh ha geographical area and, thus, this increase in yield has to be achieved from the existing cultivated area with primary focus on the following aspects:

Irrigation

Water is one of the most vital natural resources of Himachal Pradesh and the state is richly endowed with a hilly terrain having an enormous volume of water. Country's five major rivers viz., Sutlej, Beas, Ravi, Yamuna and Chenab originate from Himachal Pradesh irrigate the land in Punjab (98%), Haryana (90%), Rajasthan (40%) and even across the border in Pakistan (GOI 2015). These perennial rivers are fed by rains and snow and are protected by a fairly extensive cover of natural vegetation. As such, the state has enormous potential of water resources in the form of glaciers and rivers but ground water resources are limited. About 90% of state drainage forms

Table 1. Distribution of agricultural households by major source of income during 2015-16 (%)

All-India/ HP	Cultivation	Livestock	Other agricultural activity	Non-agricultural enterprises	Wage/ salaried employment	Others
Himachal Pradesh	38.7	1.8	0.2	8.6	35.3	15.4
All-India	63.5	3.7	1.1	4.7	22.0	5.1

(NSSO 2014)

Table 2. Source- wise average monthly income during 2013 (Rs./household)

All-India/ HP	Income from wages	Net receipt from cultivation	Net receipt from farming of animals	Net receipt from non-farm business	Total income	Consumption
Himachal Pradesh	4030	2876	1047	824	8777	7134
All-India	3019	2146	3194	784	6653	6229

Chandrasekhar and Mehrotra (2016)

the part of Indus river system.. The gross irrigation potential of the State is estimated to be 3.35 lakh hectares that will cover about 60% of the cultivated area. Because there are certain hinterland areas having undulating topography where lifting of irrigation water from deep downstream is impossible. In such areas, rainwater harvesting may be the most suitable and viable option. Presently, in the state only 19% of the total cultivated area has assured irrigation. Therefore, enhancing area under irrigation should be the top priority issue. Micro irrigation through drip and sprinkle irrigation followed by microstructure for rainwater harvesting, check dams and lift irrigation from natural water bodies and rivers would pave the way to cover more area under irrigation. Plan should aim to bring at least 10% of the total cultivated area under irrigation every year leading to 69 % over a period of 5 years. There is a need for a paradigm shift in water management in rainfed areas. Here the emphasis should be on securing water for bridging dry spells and on improving agricultural and water productivity through new technological water management options.

Fertilizers

Agriculture soils are increasingly deficient in micronutrients and the NPK balance has shifted away from the norm of 4:2:1 and is skewed towards nitrogen. The widespread secondary and micronutrient deficiencies have led to deterioration in soil health leading to low fertilizer response and crop yields. The degrading soil health trend can be reversed through adoption of soil test based application of deficient secondary and micronutrients to harness existing productivity potential on a sustainable basis. Use of macro as well as micro nutrients is most important. It is interesting to note that farmers in the state use less than half of the recommended dose of NPK which augurs well for promoting organic agriculture. Emphasis on soil health testing to determine appropriate dose of NPK and other nutrients is also required. There is need to have more attention on soil health cards, use of neem coated urea, and the promotion of traditional farming practices through the *Paramparagat Krishi Vikas Yojana* (PKVY) which can lead to more income to the farmers.

Crop diversification

The state is endowed with wide range of physiographic, climatic, soil and biological diversity; hence there exists ample scope for intensification of existing cropping systems through crops diversification. The entire state is conducive for growing a wide range of fruits, vegetables and other cash crops. Small areas with their own micro-climatic conditions and niches provide suitable sites for growing particular crop. Diversification of agriculture offers food and nutrition security, income growth, diversification of sources of income, poverty alleviation, employment generation, judicious use of land and water resources, sustainable agricultural development, and environmental improvement. Shifting to high value crops especially in irrigated areas is an important source to increase/double farmers' income. Diversification of existing maize - wheat system towards cash crops based system (Table 3) certainly will help to fetch higher farm profit to the farmers.

2. Quality seed production

Quality seed production and its replacement is very important. Presently, the rate of seed replacement is less than 20% in pulses, and below 30 % in wheat and paddy (Sharma 2017). Quality seed replacement needs to be increased to at least 33% in high yielding varieties and 100 % in hybrids of all crops. Increase in the breeder's seed production which recently has declined by about 40% compared to 2010-11. There is need for the provision to create community seed banks besides, regulatory measures to ensure quality seeds and check spurious seeds. Quality seed on hand will help to increase the yield on farmers' field but as a grower production of quality seed of recommended verities/hybrids can help to fetch a handsome income to the farmers. The data in Table 4 enumerate the profitability of different crop sequences. Farmers can adopt different models depending upon the suitability of land and resources for raising a good seed crop to earn a good profit from the seed crops.

3. Livestock farming

Livestock is an integral part of farming and has enormous potential for increasing the agricultural growth as well as farmers' income in coming years. While the farmers' income in India from cultivation of crops is growing at the rate of 4.3% per annum, the income from livestock sector is growing at the rate of 14.9% per annum (NCEAR 2017). Livestock contributes 25-30% of the total farm income per household in Himachal Pradesh. Its contribution is reported still higher than that of crop production in high hills zone of the state. For increasing productivity of small and marginal farmers and doubling the farm income, ancillary farm activities are needed

to be incorporated along with diversification towards high value activities like dairying, backyard poultry, goat rearing, along with other farm activities. If income of farmers has to be doubled then income from farm animals can prove to be a viable option.

Table 3. **Alternative/diversified cropping system for low & mid hills of Himachal Pradesh**

Cropping Sequence	Net returns(Rs./ha/year)	Net returns(Rs./0.5ha/month)
Maize-Wheat	21,564	898 traditional
Babycorn + Frenchbean – Pea –Summer squash	2,61,600	10900*
Babycorn + Asparagus bean - Pea – Summersquash	2,89,288	12054*
Brinjal - Garlic	38,131	1588
Brinjal - Broccoli- Wheat	38,151	1590
Okra-Radish-Onion	1,28,622	5360*

*Cropping system with enhanced income per household farmer holdings of an average size 0.5 ha

Table 4. Profitability of seed production with land holding of one acre (10 *kanal*)/household

Cropping Model	Kharif Net profit Rs./ha	Rabi Net profit Rs./ha	Net Profit* Rs./ha/annum
Model 1	Paddy	Wheat	
	27000	7100	34100
Model 2	Paddy	Chickpea	
	27000	17600	44600
Model 3	Blackgram	Wheat	
	21600	7100	28700
Model 4	Blackgram	Chickpea	
	21600	17600	39200

* Based on current prices

Livestock also imparts resilience to household income and does not fluctuate from year to year unlike agricultural production. Currently average milk yield is 4.9 kg/day in buffalo and 3.1 kg//day in case of cow (Sharma 2017). Obviously, doubling milk productivity would double the income of the farmers. To achieve this, livestock needs support in terms of resources to create adequate health care infrastructure (to control diseases and promote health, quarantine and hygienic services). Challenges like growing number of unproductive male bulls and cows, shrinking access to fodder, weeds infestation in pastures/grasslands, diminishing common property resources (community lands, forests, water) and feed in rain fed areas are posing threats. Emphasis needs to be given for establishing cattle breeding or converting *Gaushalas* into cattle breeding/rehabilitation centers to convert non-productive animals into productive one.

The experts have assessed that by maintaining a dairy unit comprising 2 adult cattle, five goats, one buck and fifty poultry birds under rural integrated farming system with total fixed and variable costs of about 2.11 lakh, a farmer can earn about Rs. 98,000 per annum with monthly income of Rs. 8167.

Establishing at least one dung-based biogas gas plant in each district to utilize cow dung and urine from *Gaushalas*, farmers can generate income through biogas and organic fertilizers and solving the burgeoning problem of stray/abandoned animals.

4. Vegetable production

The important role of vegetables in diversification and improving the socio-economic conditions of small and marginal landholders is well recognized. During the last three decades Himachal Pradesh has made discernible progress in the production of vegetable crops. The production of vegetable crops in the state has increased steadily from 365 thousand tonnes in 1970-71 to a record level of 1581 thousand tones during 2015-16 (Anonymous 2016). Further, the introduction and adoption of new hybrids of vegetable crops by the farmers fueled high growth in vegetable production. Most of these crops are off-season in nature fetching lucrative returns to farmers.

Vegetable production induces commercialization of agriculture in the rural economy, and generates employment and incomes. The high income from vegetable crops has been confirmed by various studies. A study under '*Rashtriya Krishi Vikas Yojna* (RKVY)' indicated fairly high net returns through cultivation of vegetable crops varying form Rs. 43,861/- to Rs. 2,73,140 per hectare (Table 5).

5. Protected cultivation of vegetables

The protected cultivation technology holds special significance for hilly areas of Himachal Pradesh where arable land is scanty and there is a great variation in agro-climatic conditions. Obviously, protected cultivation has come as a boon to marginal and small farmers who can now think of earning descent livelihood from their small land holdings which otherwise was a distant dream for them. The main advantage of protected cultivation is that it ensures high productivity and provides self-employment avenues to the youth and the rural population. Since, protected cultivation is purely a commercial agri-business venture with substantial initial investment; it is the value realization rather than physical output that matters most to the entrepreneurs/farmers.

The studies conducted at various agro climatic locations of the state indicated high income potential from protected cultivation of vegetable crops. Different vegetable cropping systems produced substantial returns ranging from Rs. 47,000 to Rs. 50,000 from 250m^2 area and Rs. 29,000 to Rs. 34,000 from 100m^2 area (Table 6). Similarly, cultivation of vegetable crops in kitchen gardening under backyard cultivation system under open condition or in small scale polyhouse will also help to maintain a round the year supply of vegetable *vis-à-vis* income to farming families.

6. Ancillary enterprises

As mentioned earlier, we have to diversify the income base of farmers by incorporating options other than farming to supplement income. Among these, beekeeping, mushroom cultivation, bio gas generation, agro processing, etc., are such avenues of income and employment in the state. The different ancillary enterprises which can contribute in increasing the income of farmers are described below and also enlisted in Table 7.

Apiculture

Presently, there are around 500 commercial bee keepers with 80,000 bee colonies capable of producing about 1600 tonnes of honey annually Ten colonies of *Apis mellifera* honey bee maintained with initial cost of about Rs. 40,000/- after three years can multiply to 25 colonies with harvest of about 250 kg of honey yielding worth Rs. 50,000/- per year

Table 5. Returns from different vegetable crops (Rs/ha)

Crop	Gross Returns	Net Returns
Capsicum (Solan)	5,85,000	2,73,140
Pea (Kinnaur)	4,97,745	2,49,446
Pea (Lahaul & Spiti)	3,14,750	1,05,400
Ginger (Sirmaur & Bilaspur)	3,61,850	71,150
Tomato (Solan & Sirmaur)	4,15,950	43,861
Garlic (Sirmaur & Kullu)	3,30,000	47,386

Source: Department of Agricultural Economics, Extension Education & Rural Sociology, CSKHPKV, Palampur

Table 6. Economics of vegetable cropping system in polyhouses

Location	Cropping system	Output (q)	Gross returns (Rs)	Variable cost (Rs)	Net returns (Rs)	Output-input ratio
Palampur						
Polyhouse-I ($250m^2$)						
Cropping season-I	Capsicum (March-November)	12.00	36000	17554	18446	2.05
Cropping season-II	Garden Pea (November-February)	5.50	11000	9834	1166	1.12
	Total		47000	27388	19612	1.72
Polyhouse-II ($250m^2$)						
Cropping season-I	Cucumber (March-August)	13.00	26000	16373	9627	1.59
Cropping season-II	Tomato (September-February)	12.00	24000	16476	7524	1.46
	Total		50000	32849	17151	1.52
Dhaulakuan						
Polyhouse-I ($100m^2$)						
Cropping season-I	Capsicum (March-November)	5.82	11640	7908	3732	1.47
Cropping season-II	Frenchbean (December-February)	4.50	18000	3741	14259	4.81
	Total		29640	11649	17991	2.54
Polyhouse-II ($100m^2$)						
Cropping season-I	Tomato (March-October)	8.26	16520	6738	9782	2.45
Cropping season-II	Frenchbean (December-February)	4.50	18000	3741	14259	4.81
	Total		34520	10479	24041	3.29

Source: Department of Agricultural Economics, Extension Education & Rural Sociology, CSK HPKV, Palampur, Publication No. 74.

Table 7. Ancillary enterprises and their contribution

Sr. No.	Source of Income/ Enterprises	Proposed working model / Household	Cost Fixed/variable (Rs)	Gross Earning (Rs)	Net earning (Rs)/annum	Net earning per month*
1.	Honey	No of colony = 50 (large scale)	1.52 (stationary colonies) to 1.86 lakh (migratory) (fixed cost); 0.54 to 0.87 lakh (variable)	0.99 to 1.94 lakh	0.22 to 0.77 lakh	1834 to 6417
		If No. of colonies = 10 (small scale)	0.40 lakh	0.50 lakh	0.30 lakh	2500
2.	Mushroom (Two crops Oct-Mar & One summer)	No of bags = 200	40000 Fixed without subsidy 13500 variable	0.60-0.70 lakh	0.35 to 0.57 lakh	3000-4750
3.	Vermi-compost	Size = 12 x 5 x 2.5 cu. Ft 5 units	90000 -1.80 lakh Fixed cost / 22500 Var. cost	90000 on var. cost	67500	5625
4.	Biogas Plant for self-sustainable Gaushala		7.00 lakh fixed 1.50 lakh/year	2.70 lakh/ month	1.20 lakh/ month	6000/day
	Biogas for 4-5 animals		0.90 lakh/year	1.62 lakh	0.72 lakh	6000
5.	**Food processing and value addition**					
	i. Bakery confectionary		1.30 lakh fixed 7.16 lakh/year	8.69 lakh	1.53 lakh	12700
	ii. Beverages & manufacturing unit		2.84 lakh fixed 8.05 lakh/year	9.77 lakh	1.72 lakh	14334
	iii. Papad Manufacturing Unit		1.80 lakh fixed 8.10 lakh/year	9.83 lakh	1.73 lakh	14335
	iv. Pickle Preparation Unit		2.19 lakh fixed 8.40 lakh/year	10.19 lakh	1.79 lakh	15000
	v. Jam, Jelly and Murabba Manufacturing Unit		2.34 lakh fixed 4.89 lakh/year	6.32 lakh	1.43 lakh	12000
	vi. Power Atta Chakki (Wheat Milling Unit)		1.36 lakh fixed 2.94 lakh/year	3.57 lakh	0.63 lakh	5600
	vii. Frymes Manufacturing Unit		2.29 lakh fixed 22.00 lakh/year	26.70 lakh	4.70 lakh	39000
	viii. Soya milk, Paneer & Curd Making unit		2.38 lakh fixed 9.98 lakh/year	11.69 lakh	1.71 lakh	14175
	ix. Organic produce/ grain packaging & management unit		3.13 lakh fixed 33.15 lakh/year	35.98 lakh	2.83 lakh	23600
6	Wages (MGNREGA)	Employed in agriculture and allied activities	No cost involved	**-**	0.60 lakh	5000

* At current prices level

and a profit of Rs. 30,000/- per year. Honey bees can also enhance the productivity of crops through pollination. In cucurbits, cruciferous crops and apple the yield has increased up to 50-70 per cent. Thus, introducing honey bees in integrated farming system will lead in the sustainable crop production beside direct income to farmers.

Mushroom cultivation

Mushroom cultivation is another potential avocation which is highly lucrative agro-industry and rank first among all the horticultural and agricultural activities. At present, mushroom production in India is around 50,000 tons with growth rate of 25-30% annually. Himachal Pradesh is pioneer state in mushroom cultivation and there is vast potential in valley areas because of low temperature and high humidity for most part of the year. Paddy and wheat are the main agricultural crops and their byproducts/straw are the basic raw materials for cultivation of white button mushroom and *Dhingri*. Mushroom unit of 200 bag capacity requires a total expenditure of about Rs, 45,000 and is capable of producing 6-7 q of mushroom from two crops of three months each with net income of Rs. 30,000 to Rs. 50,000 depending upon the market price.

Vermicomposting

Vermicomposting is a simple technology for converting organic wastes into organic composts with the help of earthworms and thereby converting wastes into income earning proposition. In present context, demand for vermicomposting is increasing and government is also giving subsidy. During 2015-16 the Government of Himachal Pradesh had proposed to set up 20,000 vermicompost units with 50% subsidy. Five vermicompost units of 12x5x2.5 feet size require fixed cost of Rs. 9,000-18,000 depending upon the material used for the construction of the unit. The variable cost for working of these units comes about Rs. 22,500. After proper functioning, these units will be able to generate net returns of Rs. 67,500 per annum with monthly income of Rs. 5,625.

Biogas plant

Biogas typically refers to renewable energy source and in many cases exerts a very small carbon footprint. Small scale biogas plant for households rearing 4-5 animals will cost about Rs. 7,500 which can lead to a net profit of Rs. 6,000 per month. Large size biogas plant is an economical alternative for community cooking or decentralized power generation with the existing available resources in the rural areas. Large scale biogas plants can help to create job opportunities for many rural youths. A biogas plant of $50m^3$ size can be feasible for dairy or *Gausalas* having about 100 adult cattle. Daily dung requirement of this plant will be about 1000 kg and gas produced from this plant can meet out the cooking requirement of 219 persons per day. The slurry production will be about 750 kg per day with NPK constitution of 1.8:1: per cent. The fixed cost including construction comes about to be Rs. 7. 0 lakh with variable cost of Rs. 1.50 lakh per month, hence total cost involved per month will be Rs. 8.50 lakh. This system will be capable to produce 100-litres milk (considering 20% of the animals are in milking), biogas and slurry of Rs. 3,000 per day. Gross returns per month will be Rs. 2.70 lakh with net returns of Rs. 1.20 lakh. The returns are sufficient to meet out the cost of the plant within six months. In addition to cooking, biogas can also be effectively used for the generation of power. Through a biogas- based power generation system, the high calorific value of biogas (approximately 74 kcal or 20 MJ) could be turned into electricity after dewatering and cleaning of the gas.

Food processing and value addition

Bakery confectionary

With the development of new food technologies, a variety of bakery products can be prepared keeping in view the market demand under present scenario. Capital expenditure required for a unit of 500 square feet will be about Rs. 2.50 lakh. This unit with 80% capacity utilisation will incur Rs. 7.16 lakh of total cost (Rs. 1.30 lakh fixed cost & Rs. 5.86 lakh variable cost). The projected sale of the unit will be Rs. 8.95 lakh per annum resulting into net returns of Rs. 1.53 lakh per annum.

Beverages manufacturing

The simple technology for manufacturing of this product can be taken up. The establishment of this unit will help generate substantial income to entrepreneurs. Capital expenditure for a unit of 1000 square feet will be about Rs. 7.50 lakh. This unit with 80% capacity utilisation will cost about Rs. 8.05 lakh (Rs. 2.84 lakh fixed cost & Rs. 5.21 lakh variable cost). The total projected sale of the unit will be Rs. 10.06 lakh per annum yielding net returns of Rs. 1.72 lakh per annum.

Papad manufacturing

Papad can be prepared with different tastes indifferent regions. Automation to the process of manufacturing *Papad* can also be done. The activity helps for creation of more employment opportunity in the state especially for women. Capital expenditure of about 1.75 lakh is required to establish 300 square feet *Papad* manufacturing unit. With 80% capacity utilisation the fixed and variable cost of Rs. 1.80 lakh and 6.30 lakh, respectively accounts for total cost of Rs. 8.10 lakh. The unit will be capable to earn net profit of Rs. 1.73lakh per annum.

Pickle preparation

Capital expenditure of about 3.50 lakh is required to establish a unit extended in area of 1000 square feet. With 80% capacity utilization the fixed and variable cost of Rs. 2.19 lakh and 6.21 lakh, respectively accounts for total cost of Rs. 8.40 lakh. After proper functioning with 80% capacity utilization this unit will be capable to earn a profit of Rs. 1.79 lakh per annum.

Jam, Jelly and Murabba manufacturing

Locally available raw material of basic ingredients can be easily processed for the preparation of jam, jelly and *murabba*. An amount of Rs. 7 lakh is required as capital expenditure to establish a jam, jelly and *murabba* unit of 1000 square feet. This needs Rs. 2.34 lakh as fixed cost and Rs. 2.55 lakh as variable cost i.e. Rs. 4.89 lakh as total cost to run the manufacturing unit. Assuming 80% capacity utilization the unit can earn a net profit of Rs. 1.43 lakh per annum.

Power operated flour mill

A flour mill set up in 300 square feet area having electric motor of with 10 HP power can be established with capital expenditure of Rs. 1.75 lakh. To run the unit, fixed cost of Rs. 1.36 lakh and variable cost of Rs. 1.58 lakh may be required. With 80% capacity utilization, the output of this unit will be about 1200 quintals of flour per annum and a net profit is estimated to be about Rs. 63,000 per annum.

Frymes manufacturing

Frymes is a brand name for rice wafer/savoury products produced by cooking rice flour. The product has taken a good market in recent years and a number of varieties of frymes are available. A fryme manufacturing unit having an area of 1000 square feet can be setup with capital expenditure of Rs. 4.50 lakh. Thereafter with Rs. 22.00 lakh (Rs. 2.29 lakh fixed cost and Rs. 19.71 lakh variable cost) operation cost this unit can earn Rs. 4.70 lakh net profit per annum.

Soya milk, Paneer and Curd making

Soya milk and its derivatives are the cheapest source of protein and its derivatives *Tofu* (soya paneer/cheese) can be used in dishes and snacks. A unit in 1000 square feet with annual production of 250q can be established with capital investment of Rs. 7.50 lakh. To run the unit with 80% capacity utilization the operational fixed and variable costs requirement will be Rs. 2.38 lakh and Rs. 7.61 lakh, respectively amounting to total cost of Rs. 9.98 lakh. This unit will be capable to have a net profit of Rs. 1.71 lakh per annum.

Organic produce packaging and marketing

The goal of organic agriculture is to optimize the health and productivity of interdependent communities of soil, light, plants, animals and people. A unit having capacity to process2000 quintals of produce per annum can be established with capital investment of Rs. 4.50 lakh. This unit utilizing Rs. 3.13 lakh and Rs. 30.02 lakh as fixed and variable costs, respectively will be able to earn a net profit of Rs. 2.83 lakh per annum.

Wages/salaried employment

Around 35% income is coming from wages and salaried employment. One member of each agricultural household and landless farmers may be ensured employment through MGNREGA and other employment generating schemes throughout the year. MGNREGA may include Integrated farming systems for providing employment. This way MGNREGA alone could generate income of Rs. 5000-6000/- per month per household besides, enhancing production and productivity of Integrated farming components.

7. Ensuring remunerative prices to farmers

Farmers receive only the price of their primary product which is sold just after the harvest. The primary product when processed after post-harvest turned secondary fetches far more income than the primary. If farmers are to be benefitted they should be ensured part of profit middlemen getting from secondary and tertiary products. A mechanism is to be devised to monitor the primary product, that is just like intellectual property rights of farmers/producers from which secondary and tertiary products are developed and the total profit earned

till final consumption of all products. A percentage share must go to the original producer of primary product. This will also do away with the minimum support price as maximum saleable price to the farmer. The goal of doubling the income of the farmers by 2022 cannot be achieved by raising production alone unless the increased physical output is marketed efficiently. The farmers receive just 45 to 50 per cent of the price paid by consumers. In this backdrop, the efficient and organized supply chain holds the key for providing incentives to farmers. The states like Gujarat, Maharashtra and Andhra Pradesh could achieve better growth in farm sector due to organized marketing through farmers' cooperatives. These cooperatives can play a catalytic role in boosting the agricultural growth in Himachal Pradesh where holdings are small and scattered and marketing cost is very high due to diseconomies of scale. There is a need to develop an ideal cooperative marketing model to supply critical inputs, create modern infrastructure and foster supply chain linkages with prospective buyers/markets. This in turn would reduce marketing costs/margins and ensure 75-80 per cent share of producers in consumer's price. The flow diagram below presents such type of cooperative marketing model to ensure remunerative prices to farmers (Fig.1).

8. Pradhan Mantri Fasal Bima Yojana

PMFBY has been launched to improve farmers' income by cover contingencies like crop failure, germination failure, crop damaged at harvest and lack of marketing of produce in 14 days after harvesting.

9. Better access to available agricultural technology know-how

Only 41 per cent of the household farmers have access to one or the other technologies developed and available for use. The following table depicts the status of different sources of technological access.

Source	% of households reporting access
Extension agent	6.2
Krishi Vigyan Kendras (KVKs)	2.7
Agricultural University/College	1.2
Private commercial agents including drilling contractors	1.2
Progressive farmers	7.4
Radio/TV/Newspaper/internet	20.0
Veterinary department	19.6
NGOs	8.0
Any agent	40.6

10. Effective and efficient dissemination of technology

In order to achieve dissemination of technology complementarities approach has to be initiated. In complementary approach allied enterprises like dairy, protected cultivation, mushroom cultivation, apiculture, floriculture, home science, bakery and marketing etc. are to be adopted besides the main enterprise. Now the question is how this target of technological dissemination and income generation can be achieved. To achieve this we must aim at:

i) Formulation of Self Help Groups (SHGs) and their encouraged participation in different income generation activities.

- Creation of self- help groups consisting 15-20 farmers at village level.
- Training to all members of the group in different activities in such a manner so that each member is trained in one activity and group as a whole in all the activities.

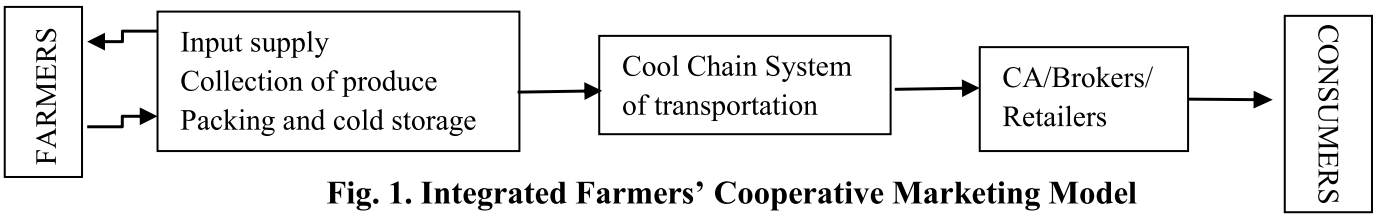

Fig. 1. Integrated Farmers' Cooperative Marketing Model

– Enhance marketing potential of Self Help Groups.

– Coordination of these SHG through different line departments under overall leadership of university experts.

ii) Assign role and responsibility to expert leaders and officials of line department with achievable defined targets.

iii) Identify common land of panchayat and non-cultivated cultivable land of farmers in the village.

iv) Switch over to collective and contract farming. Pool land and use for agriculture and allied activities through SHGs on pre-determined terms and conditions to share income among SHGs and owners.

v) Identify main and allied activities in orders of preference and suitability depending upon geography, climate conditions and available resources at panchayat /village level.

vi) Include agriculture and allied activities in MGNREGA programme and ensure all cultivable but fallow land be brought under cultivation.

vii) Promote *Paramparagat Krishi Vikas Yojana* (PKVY). This is possible through Zero Budget Natural and Organic Farming to reduce costs of inputs and cultivation. Himachal Pradesh by default is organic. On an average 54 kg chemical nutrients are consumed compared to 350 to 500 kg in plain area. Focus to follow Sikkim Model – that is practicable and achievable. In order to achieve this establish small units of organic input production at village level through farmer's participation.

viii) Strengthen the *Mera Gaon Mera Gaurav* scheme of the KVKs in the state under which various activities like visits to village, trainings, *Kisan Gosthis* and demonstrations are being conducted.

Proposed Action Plan at the level of Agriculture & Horticulture Universities, line Departments and Farmers

Agriculture being hi-technology driven avocation requires the transfer of developed technology from labs to end-user farmers. However, existing estimates revealed that only 41 % of the developed technology has reached to beneficiary farmers, while 59 % is yet to reach the end-users. Since SAUs being the technology generators, the mandate of transfer of technology is of the State government line departments. The SAUs perform 1/3rd of its function in demonstrating technology through KVKs, advisory services, front-line demonstrations and on-farm trials. The major chunk of budgetary provision as well as technical manpower at grass root level lies with the line departments. Under such circumstances, the SAUs could be given responsibility to lead the line department field functionaries in achieving the target of dissemination of technical know-how to farmers for that proposed action plan under:

i. A committee consisting of Scientists, Subject Matter Specialists from line departments like horticulture, agriculture, animal husbandry, Progressive farmers, NGOs be constituted for each block/ panchayat. Agricultural and Horticultural Universities can take the lead.

ii. There are 75 blocks in the state. These blocks can be divided between two universities keeping in view the available expertise as well as looking into existing cropping patterns and potential to grow different crops in view of micro agro-climatic niches.

iii. Each university may be allotted 35-40 blocks depending upon the factors mentioned above.

iv. Committee should be entrusted with the task of preparing block and panchayat level plan identifying potential crops/allied activities and constraints in increasing farmer's income.

v. A team to coordinate and keep liaison among different departments for technology and infrastructural support like road, electricity, marketing yards, and so on.

vi. Need to create synergy between various programmes launched to double the farmers' income

vii. Committees will identify cluster of villages/ panchayats where particular crops can be grown and also where other allied activities/ enterprises like animal husbandry, mushroom, bee-keeping, floriculture, vegetables, protective cultivation and food processing etc. could be started. Plan must be crop specific, activity specific, and climate & soil type specific that can produce empirically verifiable

indicators of success.

viii. Ultimately, roadmap delineating sub-sector wise interventions, targets and financial resources required needs to be prepared for each block and panchayat.

ix. These target based indicators need to be closely monitored every month/season/year and mid- term course correction be made to ensure that the income of each section of the farming community like marginal farmers, landless workers doubles.

x. At later stages, resources allocated under different programmes can be routed through these committees and distributed among different activities/crops as per identified potential and targets.

Acknowledgments: Author acknowledges contributions of all the departments of constituent colleges for organizing seminars to deliberate on the issue of doubling farmers' income and provide inputs. The expert support from Professors H.R. Sharma, K.D. Sharma, Harbans Lal and Naveen Kumar in compilation and Dr. Hriday Pal Singh in editing of the manuscript is also duly acknowledged.

References

Ambika KS and Naika VRK. 2011. Education technology usage in a State Agricultural University of Karnataka: Journal of Global Communication **4** (1): 73-79.

Anonymous. 2011. Annual Progress Report. All India Coordinated Project on Farming System Research, Department of Agronomy, Forages and Grassland Management, CSK HP Krishi Vishvavidyalaya, Palampur. p5.

Anonymous. 2016. Department of Agriculture, Himachal Pradesh.

Chand Ramesh, Sexena Raka and Rana Simmi. 2015. Estimates and analysis of farm income in India, 1983-84 to 2011-12. Economic & Political Weekly **22**:139-145.

Chandrasekhar S and Mehrotra Nirupam. 2016. Doubling farmers 'income by 2022: what would it take? Economic & Political Weekly **18**:10-13.

Chauhan SK and Sharma KD. 2015. A study on production potential, economic viability and marketing system of varied size mushroom units in Himachal Pradesh. Department of Agricultural Economics, Extension Education & Rural Sociology, CSK HP Krishi Vishavidyalaya, Palampur. Publication73. pp121.

GOI. 2015. State of Indian Agriculture 2015-16. Ministry of Agriculture & Farmers' Welfare (Directorate of Economics and Statistics), New Delhi, p 252.

Guleria JS and Kumar Ashok. 2015. An economic analysis of TOFU production (Soya Paneer) in soya processing unit of CSK HPKV, Palampur, Himachal Pradesh (India). Department of Agricultural Economics, Extension Education & Rural Sociology, CSK HP Krishi Vishvavidyalaya, Palampur, Research Report. pp 8.

Joshi PK. 2001. Education technology adoption and agricultural productivity. Indian Journal of Agricultural Economics **53** (1):19-22.

Khatik GL.1997. Agricultural technology adoption behavior of rural farmers. Indian Journal of Extension Education **33** (3-4):133-138.

Kumar Arun, Sharma SK and Chauhan SK. 2015. Apiculture for livelihood. **In**: Technology for Livelihood Enhancement, eds. VL Chopra and Sanjay Kumar, New India Publishing Agency: 549-577.

Kumar Virender. 2013. Estimation of cost of cultivation of commercial crops in Himachal Pradesh. Department of Agricultural Economics, Extension Education & Rural Sociology, CSK HP Krishi Vishvavidyalaya, Palampur. Publication No. 64. pp17.

Kumari Anita and Dhaliwal YS. 2017. A study on nutritional composition and value addition of crab apple (*Malus vaccata*). American Journal Food Science and Technology **5** (1):19-22.

Kumari Anita, Dhaliwal YS, Sandal Anupama and Badiyal J. 2013. Quality evaluation of *Cydonia ablonga* (Quince fruit) and its value added products. Indian Journal of Agricultural Biochemistry **26** (1):61-65.

NCEAR 2017. Doubling Farmers' Income by 2022: Backdrop and Challenges. Rajesh Chadha *et al*., Research Team, National Council of Applied Economic Research, New Delhi-110 002.

NSSO 2014. National Sample Survey Office, Ministry of Statistics and Programme Implementation. Statement 6, p15.

Pal Suresh and Tripp Robert. 2002. India's seed industry reforms: prospects and issues. Indian Journal of Agricultural Economics **57** (3):443-458.

Ramaswami B. 2002. Understanding the seed industry: contemporary trends and analytical issues. Indian Journal of Agricultural Economics **57** (3):417-429.

Sharma HR, Sharma KD, Chauhan SK and Sharma HL. 2011. Impact assessment of wheat research in Himachal Pradesh. Himachal Journal of Agricultural Research **37** (1):198-209.

Sharma HR. 2017. Doubling Farmers' Income by 2022: Status, Strategies and Action Plan. Lecture delivered on the occasion of Swami Vivekananda's Jayanti on March 12,2017 at CSKHPKV, Palampur.

Sharma HR.2011. Crop diversification in Himachal Pradesh-pattern, determinants and challenges. Indian Journal of Agricultural Economics **66** (1):97-114.

Sharma KD and Pandit Sahivi. 2014. Performance of milk marketing and processing cooperatives in Himachal Pradesh. Indian Cooperative Review **52** (2): 90-104.

Sharma KD, Pathania MS and Lal Harbans. 2010. Value chain analysis and financial viability of agro-processing industries in Himachal Pradesh. Agricultural Economics Research Review **23** (Conf. No.): 515-522.

Sharma KD, Pathania MS, Bala Brij and Gupta Manoj. 2015. Technological intervention for protected cultivation of vegetable crops (Phase-II&III) under RKVY. Department of Agricultural Economics, Extension Education & Rural Sociology, CSK HP Krishi Vishvavidyalaya, Palampur, Publication Nos. 77& 81. pp 21& 23.