Vision 2030

Vivekananda Parvatiya Krishi Anusandhan Sansthan
(Indian Council of Agricultural Research)
Almora - 263601, Uttarakhand, India
Website: http://vpkas.nic.in

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Vivekananda Parvatiya Krishi Anusandhan Sansthan
(Vivekananda Institute of Hill Agriculture)
Indian Council of Agricultural Research
Almora – 263601, Uttarakhand, India
Tel.: 05962-230208 • Fax: 05962-231539
E-mail: vpkas@nic.in
Website: http://vpkas.nic.in

Guidance
Dr. J.C. Bhatt
Director

Compilation
Mr. K.K.S. Bisht, Dr. Lakshmi Kant & Dr. J. K. Bisht

Technical Assistance
Mrs. Renu Sanwal & Mr. R.K. Kanojia

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डॉ. एस. अय्यप्पन
सचिव एवं महानिदेशक
Dr. S. AYYAPPAN
SECRETARY & DIRECTOR GENERAL

भारत सरकार
कृषि अनुसंधान और शिक्षा विभाग एवं
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कृषि मंत्रालय, कृषि भवन, नई दिल्ली 110 114

GOVERNMENT OF INDIA
DEPARTMENT OF AGRICULTURAL RESEARCH & EDUCATION
AND
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
MINISTRY OF AGRICULTURE, KRISHI BHAVAN, NEW DELHI 110 114
Tel.: 23382629; 23386711 Fax : 91-11-23384773
E-mail: dg.icar@nic.in

Foreword

The diverse challenges and constraints as growing population, increasing food, feed and fodder needs, natural resource degradation, climate change, new parasites, slow growth in farm income and new global trade regulations demand a paradigm shift in formulating and implementing the agricultural research programmes. The emerging scenario necessitates the institutions of ICAR to have perspective vision which could be translated through proactive, novel and innovative research approach based on cutting edge science. In this endeavour, all of the institutions of ICAR, have revised and prepared respective Vision 2030 documents highlighting the issues and strategies relevant for the next twenty years.

Vivekananda Parvatiya Krishi Anusandhan Sansthan (VPKAS), Almora, an institute of Indian Council of Agricultural Research (ICAR) since 1974, has been engaged in agricultural research and evolving technologies required to cater to the needs of farmers of North Western Himalayan region. Agriculture is a challenging task in hills, as it faces the constraints of difficult accessibility, small and fragmented land holdings, poor and shallow soils, erratic rainfall, damage caused by the wild animals, inadequate market infrastructure and meager input availability. The majority of hill farmers still follow the age-old practices, thus fail to realize the full potential of agriculture. The challenges and opportunities, thus, call for a paradigm shift to the technology-driven agriculture and connecting the research with the farmers of the region, to attain the

desired level of agricultural growth. Adoption of the generated technologies by small and marginal farmers would build up the confidence among them for sustainable and profitable hill agriculture.

It is expected that the analytical approach and forward looking concepts presented in the *'Vision 2030'* document will prove useful for the researchers, policymakers, and stakeholders to address the future challenges for growth and development of the agricultural sector and ensure food and income security with a human touch.

(S. Ayyappan)

Dated the 29th June, 2011
New Delhi

Preface

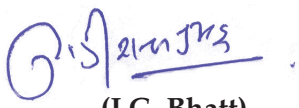
Vivekananda Parvatiya Krishi Anusandhan Sansthan is entrusted by its apex body, Indian Council of Agricultural Research, with pursuing research on different aspects of hill agriculture for providing basis for the livelihood security to the farmers of North-Western Himalayas. In this endeavor, it has developed more than 125 suitable varieties and hybrids in different crops along with the appropriate production and protection technologies and the improved technologies are disseminated among farmers through various outreach programmes. Though a large number of agricultural technologies have been developed by VPKAS and other research institutions for increasing the productivity of hill agriculture, yet the research further requires a more convergent focus on what has been termed as the "Specialty Agriculture" by Dr. S. Ayyappan, the Secretary (DARE) and DG (ICAR) due to its uniqueness and the challenges.

Beside challenges, hill agriculture offers vast opportunities too. The climate of hills, in general, is conducive for growth of a large variety of plants; therefore, many tropical as well as temperate crops are grown. It also facilitates the highly remunerative off-season vegetable and other high value crop cultivation in open and protected environments and cottage scale mushroom production. Seed production of a number of crops in hills is advantageous compared to plains. Available water potential, if harnessed, is capable of changing the entire economic scenario. Intrinsically, agriculture tenders substantial scope for organic farming.

'**Vision 2030**' is a humble effort to identify opportunities, set goals and devising strategical framework to attain the goals. With the dedication and motivation of the institute staff, the institute aspires to accomplish the mission positively. The institute is also committed to blossom the farmers' fields with its research results so that the

interest in hill farming is rejuvenated and farmers' confidence in agriculture is restored.

I express my earnest gratitude to Hon'ble Secretary (DARE) and DG (ICAR) for his invaluable guidance in preparing this document. I am also grateful to Hon'ble DDG (CS) & ADG (FFC) for their keen interest on VPKAS.



(J.C. Bhatt)
Director
VPKAS (ICAR)
Almora 263601
Uttarakhand

Dated the 28th June, 2011
Almora

Preamble

Vivekananda Parvatiya Krishi Anusandhan Sansthan (VPKAS), Almora, established by Professor Boshi Sen in 1924, became a constituent institute of ICAR in 1974. The institute is a multi-crop and multidisciplinary agricultural research institute for the north-western hills, covering the states of Jammu and Kashmir (J&K), Himachal Pradesh (HP) and Uttarakhand. Earlier, the research efforts were focused on development of high yielding, disease resistant varieties suited for rainfed and irrigated conditions; development of suitable crop production and protection technologies; conservation and management of rain water, nutrients and germplasm, fodder production and dissemination of improved technologies to the farmers of the region. Realizing the challenges and opportunities, collection, evaluation and maintenance of germplasm; breeding through conventional methods and biotechnology for biotic and abiotic stresses; monitoring of pests and integrated pest management; development of suitable eco-friendly crop production technologies; more remunerative cropping systems; monitoring of soil health hazards; organic farming; protected cultivation; designing suitable farm implements for farm mechanization and reduction of cost of cultivation; enhancing the availability of fodder round the year and effective dissemination of crop production technology have now been incorporated in the current research programme to achieve the increased levels of food/fodder and nutritional security.

In view of the challenges and opportunities of hill agriculture and to devise strategies, the first effort undertaken resulted in the document '**Vision 2020**'. Subsequently, after five years to address the changes that had taken place, '**Perspective Plan 2025**' was prepared. The present document '**Vision 2030**' compiles the key challenges and opportunities in hill agriculture in the next two decades for developing the strategies in shaping the future of hill agriculture for sustainable growth and development of the region to contribute significantly at national scenario.

Contents

Agricultural Scenario in N-W Himalayas

Hills are the rich source of bio-diversity and possess enormous potential for supporting agriculture and maintaining clean environment. They are water towers of the earth, too. Spread over 20% of the land area of the world, hills are occupied by 10% of the world's population and about another 40% live in the neighbourhood (Spehn *et al*. 2005). Thus, hills support about 50% of the world's population either directly or indirectly. Inaccessibility due to rugged and steep mountains is a major hindrance in the development of hills. Excessive/meager rainfall, relatively low temperature, poor and shallow soils and soil erosion are other major problems that plague the sustained agriculture in the hills.

Area and its contribution

According to 2001 census, 90.2, 75.2 and 74.3% of the population is rural in Himachal, J&K and Uttarakhand compared to the national average of 72.2% (Anonymous, 2006). Thus, agriculture, including livestock, continues to be the dominant sector despite the fact that they are exposed to adverse and harsh geo-physical and agro-climatic conditions. The contribution of agriculture and allied sectors to net state domestic product at factor cost (at current prices) in the region ranges between 16.8 to 28.9% (Anonymous, 2010a). The average operational holding in Himachal, J&K and Uttarakhand are 1.07, 0.67 and 0.95 ha, respectively, against the national average of 1.33 ha (Anonymous, 2010b). If we consider only hilly region, this figure will be much lower. Even this small holding is scattered over a number of locations, resulting in considerable wastage of time in movement, which could otherwise be utilized for agricultural and other chores.

Production environment and production systems

The climate of hills, in general, is conducive for growth of a large variety of plants; therefore, many tropical as well as temperate crops

are grown. The diverse agro-climatic conditions impart unique advantage and competitive edge over other states (of plain region) for cultivation of off-season vegetables, temperate fruits, aromatic rice and medicinal and aromatic plants, besides the huge potential for organic farming. Additionally, the region is the natural abode of large number of medicinal and aromatic plants.

The estimated annual soil loss from N-W Himalaya is approximately 35 million tonnes, which costs around 1.5 billion Rupees (Anonymous, 2007) besides being an immeasurable agro-ecological hazard. The irrigated area in HP, J&K and Uttarakhand, respectively, is 19%, 42% and 45% of the net area sown (Anonymous 2010b). However, most of the irrigated area in the region is in plains. For example, in Uttarakhand in totally hill districts, only about 10% area is irrigated (Anonymous 2010c). The N-W Himalaya receives an average precipitation of approximately 1300 mm (Ramakrishna *et al*., 2000). Thus, the region receives 18.71×10^6 ha-mm rain water. Dhyani *et al*. (1997) estimated the runoff potential of the area at about 42%.

The crop production systems prevailing in N-W Himalayas are based on agriculture, vegetables, horticulture/agri-horticulture, and agroforestry/ agri-horti-silvi-pastoral system. Livestock is the integral part of farming in almost all the places. However, fishery and floriculture are also the parts of production systems in certain areas. Wheat, paddy, maize, ragi, barnyard millet, lentil and soybean are the major field crops and cole crops, cucurbits, capsicum, tomato, radish, pea, french bean, potato and onions are the major vegetable crops. Among fruits, apple, peach, apricot, plum, pear etc. are the major crops.

Land use pattern

Forests enjoy the lion's share in land use in N-W Himalayas and the percent area in the region is more than double that for All India (Table 1), which is a plus from environmental point of view. A low value of area put to non-agricultural use indicates low developmental activities in Uttarakhand and the high percentage of barren area, especially in J&K, beacons the need to embark upon seeking for alternative land use. HP is the only state which has a sizeable area under permanent pastures and other grazing lands, which is a great

support to livestock. Culturable waste, especially in Uttarakhand, is probably due to migration from rural areas and calls for creating more opportunities for employment in rural areas to check migration and culturable waste. Total fallow in the region is less than the All India level. The net area sown in the region is far below the national average, which is due to high forest cover. The N-W hill states are quite ahead of All India in terms of cropping intensity, which can be further enhanced by introducing crops and/or crop varieties to fit into the areas where keeping fallow or mono-cropping is practiced.

Table 1. Land utilization (% of total reporting area) pattern in Himalayan states (2007-08)

	HP	J&K	Uttara-khand	N-W Himalayas	All India
Forest	24	54	61	48	23
Non-agricultural use	10	8	3	7	8
Barren	15	8	6	9	6
Permanent pastures and other grazing lands	33	3	4	13	3
Trees etc.	2	2	5	3	1
Culturable waste	3	4	6	5	4
Total fallow	1	3	2	2	8
Net area sown	12	19	13	15	46
Cropping intensity (%)	179	154	165	162	139

Source: Anonymous (2010b)

Hill region *vis-à-vis* plains

The comparative status of yields of different crops in hilly and plain regions of Uttarakhand shows that the yields of wheat and rice in plains are more than double that in the hills of Uttarakhand, whereas the yield of maize in plains is nearly 150% that in hilly region and the yields of millets are nearly equal in both the regions (Fig. 1). Among pulses, the yields of field pea in plains are more than 150% compared to those in hills, whereas for lentil, it is more than double and the yield levels are comparable for black gram (Fig. 2). However, pulses, like horse gram (which is known to have medicinal value

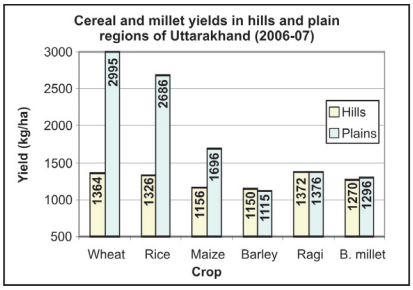


Fig. 1. Comparative yields of different crops in hills and plains of Uttarakhand

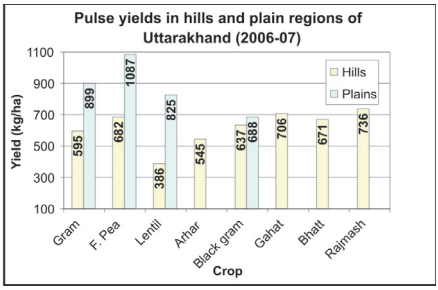


Fig. 2. Comparative yields of different pulses in hills and plains of Uttarakhand

against kidney and gallbladder stones), bhat (a variant of soybean, used as a pulse and has higher phytic acid, stachyose and mineral contents than the common soybean, which is primarily used as an oilseed) and rajmash (a pulse version of french bean, a highly remunerative crop) are grown mainly in hills, necessitating efforts to bring more area under these pulses.

The yields of *rabi* and *kharif* oilseeds in plains are more than 100 and 50%, respectively (Fig. 3). These facts caution about the rosy picture of Uttarakhand as a whole, particularly in terms of foodgrains, where hills are way behind of plains. In general, the productivity of different cereals are low in hills as compared to that of the country, with certain exceptions like the productivity of rice in J&K in 2008-09 (2186 kg/ha) against the corresponding national average of 2178 kg/ha (Anonymous, 2010b). However, generally, Uttarakhand performs better than All India in terms of millet yield.

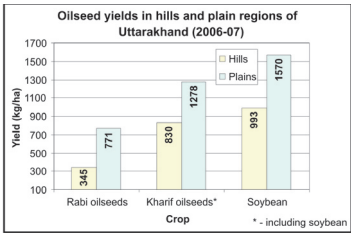


Fig. 3. Comparative yields of oilseeds in hills and plains of Uttarakhand

Surplus-deficit of agricultural produce

The states of Uttarakhand and HP enjoy self-sufficiency in respect of cereals and millets in N-W Himalaya (Table 2). The sufficiency is, however, mainly due to higher production in plains, as is evident from the discussion above, and the valley areas. Though much better off than All India, all the N-W hill states are deficient in terms of pulses and oilseeds availability (Tables 3 and 4). The region as a whole is surplus in vegetable production (Table 5), which opens up venues for export.

Table 2. Surplus-deficit in cereals and millets in N-W states (2008-09)

State	Population ('000)	Requirement ('000 t)*	Production ('000 t)**	Surplus/ deficit ('000 t)
Himachal	6629	1047.4	1377.7	330.3
J&K	11336	1791.1	1707.1	-84.0
Uttarakhand	9584	1514.3	1726.0	211.7
N-WH	**27549**	**4352.7**	**4810.8**	**458.1**
All India	**1152774**	**182138.3**	**219899.7**	**37761.4**

Requirement @ 158 kg/capita/annum

Table 3. Surplus-deficit in pulses in N-W states (2008-09)

State	Population ('000)	Requirement ('000 t)*	Production ('000 t)**	Surplus/ deficit ('000 t)
Himachal	6629	121.0	23.5	-97.5
J&K	11336	206.9	14.2	-192.7
Uttarakhand	9584	174.9	39.0	-135.9
N-WH	**27549**	**502.8**	**76.7**	**-426.1**
All India	**1152774**	**21038.1**	**14566.7**	**-6471.4**

Requirement @ 18.25 kg/capita/annum

Table 4. Surplus-deficit in oilseeds in N-W states (2008-09)

State	Population ('000)	Requirement ('000 t)*	Production ('000 t)**	Surplus/ deficit ('000 t)
Himachal	6629	242.0	5.0	-237.0
J&K	11336	413.8	49.6	-364.2
Uttarakhand	9584	349.8	26.0	-323.8
N-WH	**27549**	**1005.5**	**80.6**	**-924.9**
All India	**1152774**	**42076.3**	**27719.0**	**-14357.3**

Requirement @ 36.5 kg/capita/annum or @ 40 g/capita/day

Fodder

In order to feed 26 million cattle in N-W Himalayan states, 135 million tonnes of fodder is required (Anonymous 2007). The region does not produce adequate fodder and, therefore, faces 54% deficit

Table 5. Surplus-deficit in vegetables in N-W states (2008-09)

State	Population ('000)	Requirement ('000 t)*	Production ('000 t)**	Surplus/ deficit ('000 t)
Himachal	6629	722.6	1263.9	541.3
J&K	11336	1235.6	1023.7	-211.9
Uttarakhand	9584	1044.7	1077.6	32.9
N-WH	**27549**	**3002.8**	**3365.2**	**362.4**
All India	**1152774**	**125652.4**	**123832.7**	**-1819.7**

Requirement @ 109 kg/capita/annum
*The normative per capita requirements are based on the recommendations of Indian Institute of Nutrition, Hyderabad.
**_Source:_ Anonymous (2010b)

in green fodder and 34% deficit in dry fodder. Strategies for enhancing fodder production include use of waste/degraded land (7.9, 9.8 and 11.5% of geographical area in HP, J&K and Uttarakhand, respectively) and forest floors for fodder production (Anonymous 2007). In addition, farm spaces on terrace risers and improved crop production technology coupled with integration of agro-forestry will help in bridging the gap between demand and supply of fodder. Further, production of green fodder during winter months by cultivating dual purpose wheat adds to the opportunities to increase green fodder availability and needs to be exploited (Fig. 4).

Fig. 4. Dual purpose wheat for increasing green fodder availability

Fertilizer consumption

All the three NW hill states ranked lowest among 'major to medium fertilizer consuming states' (Anonymous, 2010b). Even Jharkhand has surpassed Uttarakhand, the highest chemical fertilizer consumer among the NW hill states, in 2009-10 which lagged behind Uttarakhand till then. However, albeit marginally, the fertilizer usage is on the increase in the region.

Future Food Requirement

Tables 6-9 present the requirements for the years 2030 and 2050 and the productivities required to fulfill the requirement *vis-à-vis* the current productivity. The populations for the years 2030 and 2050 have been calculated using linear regression (since, the value of squared correlation coefficient for linear relationship was greater than 0.99 for all the cases) between years and the projected populations for the period 2001-26 (Anonymous, 2010a). Tables 7 and 8 show that there is a huge gap between the current productivity and required productivity in future for pulses and oilseeds. Enhanced production and productivity of pulses in recent times has been arrived at by enhancing the availability of quality seed through National Food Security Mission. In order to narrow this gap, the availability of inputs particularly seed of HYVs has to be enhanced together with the vigorous extension efforts. Thus, the enhanced availability of inputs, particularly quality seed of HYVs; vigorous

Table 6. Cereal & millet requirement for the years 2030 and 2050

State	Population ('000)		Requirement ('000 t)		Required productivity (kg/ha)*		Current productivity (kg/ha)
	2030	2050	2030	2050	2030	2050	
Himachal	7899	9101	1248.0	1438.0	1628	1876	1798
J&K	14187	16873	2241.5	2665.9	2492	2964	1898
Uttarakhand	12422	15078	1962.7	2382.3	2034	2469	1789
N-WH	**34508**	**41052**	**5452.3**	**6486.2**	**2073**	**2466**	**1829**
All India	**1473456**	**1773939**	**232806.0**	**280282.4**	**2311**	**2782**	**2183**

Table 7. Pulse requirement for the years 2030 and 2050

State	Population ('000)		Requirement ('000 t)		Required productivity (kg/ha)*		Current productivity (kg/ha)
	2030	2050	2030	2050	2030	2050	
Himachal	7899	9101	144.2	766.4	4652	5358	758
J&K	14187	16873	258.9	899.3	8461	10062	464
Uttarakhand	12422	15078	226.7	965.0	3542	4300	609
N-WH	**34508**	**41052**	**629.8**	**2630.7**	**5014**	**5965**	**611**
All India	**1473456**	**1773939**	**26890.6**	**100739.3**	**1217**	**1465**	**659**

Table 8. Oilseed requirement for the years 2030 and 2050

State	Population ('000)		Requirement ('000 t)		Required productivity (kg/ha)*		Current productivity (kg/ha)
	2030	2050	2030	2050	2030	2050	
Himachal	7899	9101	288.3	332.2	21044	24248	365
J&K	14187	16873	517.8	615.9	7930	9432	760
Uttarakhand	12422	15078	453.4	550.3	17438	21165	1000
N-WH	**34508**	**41052**	**1259.5**	**1498.4**	**11995**	**14270**	**768**
All India	**1473456**	**1773939**	**53781.1**	**64748.8**	**1940**	**2336**	**1006**

Table 9. Vegetable requirement for the years 2030 and 2050

State	Population ('000)		Requirement ('000 t)		Required productivity (kg/ha)*		Current productivity (kg/ha)
	2030	2050	2030	2050	2030	2050	
Himachal	7899	9101	861.0	992.0	11526	13280	16920
J&K	14187	16873	1546.4	1839.2	25476	30300	16865
Uttarakhand	12422	15078	1354.0	1643.5	6506	7898	15336
N-WH	**34508**	**41052**	**3761.4**	**4474.7**	**10950**	**13027**	**15951**
All India	**1473456**	**1773939**	**160606.7**	**193359.4**	**20312**	**24455**	**15662**

*On the basis of current area under the crops falling in the designated category.
Source: Anonymous (2010b); for current area under crop and productivity in Tables 6-9

extension efforts, coupled with shifting of land from cereals and millets to pulses, will provide a key to narrow the gap between requirement and availability of pulses and oilseeds in the region. Table 9 highlights the need to bring more area under vegetables in J&K to meet the future requirement. Alternatively, vegetables can be obtained from HP and Uttarakhand.

Climate Change

The trend analysis of last 45 years annual rainfall data of Experimental Farm, Hawalbagh. Almora showed that an increasing trend in annual rainfall was observed till 1986, thereafter, decreasing trend prevails. An increasing trend in frequency of drought years was observed, as there were 16 drought (5 severe) years during 1964-2000, whereas 7 drought (3 severe) years were observed in

subsequent nine years. There is a decreasing trend in rainfall during *kharif* season. No clear-cut trend was observed in *rabi* season rainfall. However, a decreasing trend was observed in last decade.

The changing climatic conditions pose new challenges to hill agriculture. At present they have adversely affected the crops and pollinators' behavior and facilitated the appearance of some new diseases and insects and new races of pathogens and increased the level of damage due to diseases and insects.

VPKAS

Vivekananda Parvatiya Krishi Anusandhan Sansthan is one of the multi-disciplinary multi-crop institutes of the ICAR. The institute is located at Almora in Uttarakhand with its experimental farm at Hawalbagh and has one KVK at Chinyalisaur, Dist. Uttarkashi, in Garhwal division and another at Kafligair, Dist. Bageshwar in Kumaon division of Uttarakhand. It has networking with ICAR institutes, SAUs and KVKs spread across the North-Western hills through All India Coordinated Research Projects, Horticulture Mission for North East & Himalayan States and National Agriculture Innovation Projects. The institute conducts research on agriculture to increase the food, feed, nutrition and livelihood security to hill farmers.

Mandate

- Basic and strategic research
  - for improving productivity and quality of important hill crops.
  - on conservation and efficient utilization of natural resources.
- Development of ecologically sound and economically viable agro-production, protection and post-harvest processing technologies for different growing conditions of hills.
- Transfer of technology, research on extension methodology, organization of specialized training programmes and consultancy on hill agriculture.

Significant research contributions and success stories

The institute has made many important research contributions for the betterment of hill agriculture. One of the significant contributions of the institute is the development and release of more than 125 improved varieties and hybrids in 25 crops, having high

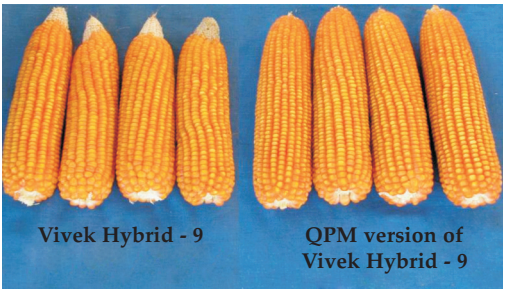


Fig. 5. Vivek Maize Hybrid 9 and Vivek QPM 9

yield potential and resistance/tolerance to biotic and abiotic stresses. Hand in hand, their matching agro-techniques have been worked according to their suitability for growing condition(s), i.e., rainfed and/or irrigated. Research work on molecular breeding with special reference to marker-aided selection led to development and release of QPM version of Vivek Maize Hybrid 9 (Fig. 5), which contains 30 and 40% more the amount of lysine and tryptophan, respectively, coupled with 10% higher yield, compared to its non-QPM counterpart. The institute maintains more than 9,000 native and exotic accessions of wheat, rice, maize, small millets, pulses, oilseeds and vegetables.

Remunerative intensive sequential cropping, intercropping, relay intercropping systems as well as integrated farming system modules have been evolved for different production conditions. Low cost water storage LDPE film-lined tanks have been designed and standardized. Micro-irrigation system has been integrated and demonstrated in large scale on farmers' fields. The water use efficiency of the irrigation system increased by 69% over the flood irrigation in Darim village of district Nainital (Fig. 6). The saving in the irrigation system was 41.1%. The B: C ratio was 2.62 when only tangible benefits were taken into account. Structural design of green houses and suitable off-season vegetable sequences have been standardized for green house cultivation. The production of vegetables doubled with introduction of these greenhouses in Bhagartola village of District Almora (Fig. 7). The average earning of the village has increased substantially with the introduction of institute's interventions.

Fig. 6. LDPF film lined tanks at Darim

Fig. 7. Institute interventions at Bhagartola village

Design, development and commercialization of Vivek Millet Thresher (Fig. 8), VL Paddy Thresher (Fig. 9) and VL Seed-cum-Ferti drill have helped tremendously to reduce the drudgery in the related operations. High finger millet threshing efficiency (> 98%) and barnyard millet pearling efficiency (> 90%) have been obtained by using Vivek Millet Thresher.

Fig. 8. Vivek Millet Thresher

Fig. 9.Vivek Paddy thresher

Farmer-participatory agro-processing centres, established at two villages in Almora district and one in Pithoragarh district, which are giving rich dividends to the entrepreneurs. The benefit cost ratio and internal rate of return for the unit at Takula are 1.39 and 36.2%, respectively, indicating sustainability of the venture.

Fig. 10. Agro Processing Center at Takula, Dist. Almora

IPM modules for inorganic and organic conditions have been developed for economically important crops like, tomato and garden pea. Bio-control formulations, based on indigenous strains of *Bacillus cereus*, *B. thuringiensis* and *Trichoderma harzianum*, were developed for management of major pests. Low cost insect trap has been designed for trapping beetles of white grub (species of *Anomala*, *Holotrichia*, etc.). The integrated effect of insect trap (Fig. 11) and *Bacillus cereus* technologies has shown a reduction of 70-90% of grubs population (Fig. 12) in two years in 18 adopted villages spread across the state of Uttarakhand.

Fig. 11. Insect Trap

Fig. 12. White Grubs

Button and *dhingri* mushroom cultivation has gained popularity in Daulaghat, a village near Almora. The farmers have benefitted a lot by mushroom cultivation and production of value added mushroom goods (Fig. 13-14).

Fig. 13. Mushroom production unit

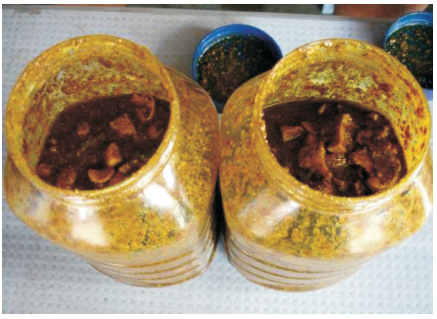


Fig. 14. Mushroom pickle

Suitable species of fodder grasses, legumes and trees have been identified and agro-techniques for production of fodders on terrace risers, degraded sloping lands, forest floor (Fig. 15) and wetland sites as well as dual-purpose wheat have been developed.

Fig. 15. Fodder production under degraded lands

VPKAS 2030

The Vivekananda Parvatiya Krishi Anusandhan Sansthan has so far been successful in delivering the expected outcomes and is moving ahead with renewed vigor to face complex challenges and to harness the diverse opportunities, in the form of available natural resources, for improving the economic status and livelihood security of the hill farmers. These efforts would lead the institute to become a leading institution in the realm of hill agriculture.

Vision

Providing basis for the livelihood security to farmers of North-Western Himalayas.

Mission

Enhancing the productivity and ecological sustainability of hill agriculture through niche based diversification.

Focus

The highest priority will be assigned to farmer-friendly research output. The strategies devised and undertaken will be the ones that lead to fruition of vision and mission of the institute. Focus will converge on following areas:

- Development of improved varieties of hill crops and their production and protection technologies for enhancing the productivity and to combat biotic and abiotic stresses.
- Devising means to enhance resource conservation, productivity and profitability.
- Development of more efficient extension methodologies.
- Promoting linkages and collaboration with other organization and public-private partnership.

Harvesting the fruits of Science

The hill agriculture is becoming more challenging than ever before as the demand for food and threat to natural resources is on increase. The institute aspires to flourish on its research work for harnessing the science for increasing crop productivity and quality, improving input use efficiency, efficient utilization of natural resources and post-harvest technology for improving quality of end products. With the emergence of new tools and technological advances the institute aims at accomplishing the mission.

Utilizing the potential of genetic-resources

The enhanced productivity of the crops in the past has been largely due to the conventional genetic manipulations of the crops. This will continue to be the primary area of research for further enhancing the productivity in hills as well. The institute holds large number of genetic resources of hill crops. The future research will concentrate on further sustainable use of available genetic resources through characterization, genetic enhancement and pre-breeding (in selected crops), molecular breeding through tools like marker-aided selection and development of trait-specific transgenics in selected crops. Priority would be given to those crops and traits which have shown low probability of success in the past through conventional approaches.

Management of natural resources and diversification of agriculture

Agriculture is highly dependent on the natural resources. Hill agriculture is predominantly rainfed but it has great potential if natural resources are managed scientifically and efficiently. Potential of conservation agriculture, zero tillage, water harvesting and micro-irrigation needs to be perfected for different production conditions of hills. Efficient farming systems, incorporating integrated crop, nutrient, pest and water management, would be further fine-tuned for wider adaptability. Conservation and optimal utilization of natural resources and enhancement in water, nutrient and carbon base would be researched upon. Emphasis will be given to enhancement of resource productivity and profitability through diversification.

Post harvest technology and mechanization

Finger and barnyard millets are the important traditional crops of the hills in rainfed areas of Uttarakhand. They are known to be nutritionally rich and with the awareness about the nutrition their demand is expected to be increase sizably. Similarly, fruits and vegetables are the important commercial crops in hills. However, 20-25 % loss in their economic value is incurred due to various factors. Value addition in these crops may be a key to uplift the economy in rainfed hill farming. Concerted research efforts in post harvest and values addition will be made to refine the technologies and making them more user friendly and affordable to small farmers. Hill agriculture is mainly dependent on farm women, but very little has been done to reduce the drudgery they encounter. Mechanization in hill farming is required to extenuate drudgery with the simultaneous increase in productivity. Focus will continue to be on developing light weight, affordable and efficient equipment for farm operations and post harvest handling.

Technology transfer

The effective delivery mechanism of the research outputs is essential for its wider adoption. Transfer of technology by various means, including print and electronic media, would help in bridging the gap between the research farm and the farmers' field productivities. Research on extension methodologies will be concentrated to achieve this end.

Strategy and Framework

Strategies, described below, would be adopted to accomplish the mission of **Vision 2030** and to ameliorate the efficiency and effectiveness of the research resources.

- Effective utilization of human and financial resources and infrastructure for improving efficiency.
  - Formulation of target-oriented inter-disciplinary and inter-institutional research and technology development programmes,
  - Prioritization of profitable and resource-based research programme suitable for small and marginal farmers of hills,
  - High priority on rainfed and marginal hill agro-ecosystem, and
  - Complementing the partners for developing improved technologies, systems and information.
- Capacity building and faster dissemination of improved technologies, knowledge and information among the clientele.
  - Develop state-of-the-art scientific facilities in laboratories and infrastructure,
  - Develop effective dissemination systems and models to link research and development system with small and marginal farmers for faster adoption, post-harvest handling, value-addition and processing, and
  - Effective linkage of research and development system with society, especially hill farmers, by improving science communication.
- Commercialization of intellectual property rights and institute technologies.
  - An intellectual property and technology management system will be strengthened for promoting science and benefiting farmers and society.

The strategic framework to be adopted for programme implementation is given in Annexure I.

Epilogue

VPKAS is committed to bring a technology-led change in the N-W hills of the country to meet challenges of the ensuring household food and nutritional security, enhancing opportunities for livelihood, sustainable management of natural resources for hill farming and agricultural growth of the region. The institute envision that technological advancement in hill agriculture would transform existing hill agriculture into a vibrant and profitable venture by effectively harnessing opportunities in domestic as well as global markets. The institute is confident by its past experiences and firmly believes that the improved technological interventions would tremendously augment small farmers' income, generate opportunities for employment, conserve natural resources and increase value addition for higher growth of hill agriculture.

The institute priority would always be the small and marginal farmers living in the inaccessible, fragile and difficult areas of hills. Its focus would always be more on the demand driven commodities and the areas where private sector does not to venture because of poor infrastructure and geographical conditions. It will also develop suitable strategies to respond to the change at national and international levels for the benefit of hill farmers.

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Annexure 1: Strategic framework

Goal	Approach	Performance measure
Improve household food and nutritional security in N-W hills	Sustainable agricultural diversification and intensification for higher productivity and quality and improving water use efficiency of depleting water resources.	Contribution of research and development in productivity enhancement, poverty alleviation and malnutrition reduction.
	Household food and nutritional insecurity assessment in N-W hills to help for better policy formulation.	
Enhance opportunities for livelihood and growth	Development of biotic and abiotic stresses tolerant HYVs of hill crops and their production and protection technologies.	Enhanced livelihood opportunities through increased profitability and improved quality of life.
	Improve efficiency and profitability of production systems for small land holdings by harvesting niche potential.	
	Promotion of profitable organic products through research inputs.	
	Develop high-value products [QPM, speciality corn (pop corn, baby corn and sweet corn), finger and barnyard millets, *bhat*, horsegram, end product quality wheat, off-season vegetables, mushroom *etc*.)] with specific traits, and their efficient post-harvest technologies.	
	Research on institutional mechanisms for efficient market channels, linkages, access and supply-chains.	
Conserve, utilize and improve the status and quality of natural resources	Conserve, efficiently utilize, enrich and sharing (as per policy) of genetic diversity.	Improved efficiencies of different inputs.
	Evolve technologies to improve soil and land quality.	Better utilized wasteland and water resources and enhanced water availability.
	Improve technological options to conserve water, enhance water-use efficiency and water availability.	Improved carbon sequestration and carbon credits gained.

Goal	Approach	Performance measure
	Technological options to use degraded and barren lands.	
	Improved technologies for niche and commodity based organic agriculture.	
	Research input for policies to get paid back for accounting ecological economics and trade in carbon credits.	
Enhance value-addition, and processing of food commodities	Evolve improved technologies for value-added products for traditional hill crop commodities and other purposes (like finger and barnyard millet husk pillow).	Developed technologies and value added products. Functional public-private partnership for commercialized agro-processed products.
	Develop machines and technologies to improve efficiencies of value added products.	Strong linkages of institute, industry and farmers and higher profit to the farmers.
	Pilot research models that link producer, entrepreneur and market.	
	Promote intellectual property rights and commercialization of technologies and food processing.	
Improve dissemination of knowledge and resources	Improve dissemination of institute technologies through effective technology transfer systems.	Developed effective transfer of technology systems, including print and electronic media and Internet, for sharing knowledge and information.
	Collection and maintenance of agriculture and allied databases.	
	Improve dissemination of information through effective use of ICT.	
Create specialized human and physical resources to address emerging challenges of hill agriculture	Modernize infrastructure and facilities, Capacity building through trainings.	Improved research efficiency. Qualified manpower in hill agriculture research, extension and agri-business.


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