Ministry of Environment, Forest & Climate Change

NABARD

TRAINING MODULE- 1

DROUGHT RESILIENT VARIETIES AND CROPPING SYSTEMS

Funded by the Ministry of Environment, Forest and Climate Change, Government of India
Under the 'National Adaptation Fund for Climate Change (NAFCC)'

Government of Himachal Pradesh
Department of Environment, Science & Technology

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Sustainable livelihoods of agriculture-dependent rural communities in drought prone district through climate smart solutions in the state of Himachal Pradesh

An initiative under:

National Adaptation Fund for Climate Change (NAFCC)

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MODULE 1 | Drought Resilient Varieties and Cropping Systems

INTRODUCTION

The impacts of climate change on agriculture and horticulture are being witnessed all most all the developing countries and more so in the state of Himachal Pradesh of India, consequently impacting the food security. Although the state has high reliance on agriculture it has direct bearing from climate variations which is being manifested as increase in temperature, changes in rainfall, loss of soil moisture and drought conditions. In order to enhance resilience of communities depended on agro-horti sector in the state; there is a need for farming communities to be educated with drought mitigation strategies to make their crop with stand against climatic incidences. Accordingly, a Training Need Assessment exercise was undertaken and training gaps were identified as Less knowledge on impact of climate change on different crop production, Inadequate knowledge on rain-fed agriculture practices, No knowledge on crop contingent plan to adopt during changing climatic condition, Poor knowledge of inter-cropping practices and their benefits, Inadequate/no knowledge and awareness on the drought resilient seed verities. Moreover, majorities of the farmers have not adopted any drought resilient variety of horticulture crops and Less knowledge and practices adopted by farmers to cope with the adverse impacts of climate change vs pest outbreaks on different agriculture and horticulture crops.

Based on the above mentioned training gaps, Module 1 focuses on drought resilient varieties and cropping systems with the objective to enhance the knowledge and skill base of the participants on the need and benefits of adopting drought resilient crops verities and different agronomic practices to make their crop withstand against climate variations. For effective facilitation of sessions, suitable case studies, video shows and interactive discussions will be organized through interactive sessions. The module is divided into five Sub-sessions. They are as here under:

- ★ Weather events of Himachal Pradesh – Perspective building
- ★ Agro-ecological zonation in HP
- ★ Strategies for enhancing resilience in rain-fed agriculture
- ★ Drought preventive measures & contingency plan
- ★ Pest control measures in different crops

MODULE OVERVIEW

Module 1 is designed to strengthen capacities of extension officials/ lead farmers to identify & implement agricultural & agronomic practices that enhances resilience of farming communities well as develop facilitation skills so that they can effectively transfer knowledge and skills to follower farmers towards climate resilient agriculture.

OBJECTIVE

To strengthen understanding of the need and benefit for adopting drought resilient varieties/ crops and climate smart agronomic practices and strengthen skills for on field demonstration.

SESSION DESIGN

Weather events of Himachal Pradesh – Perspective building	Agro-ecological Zonation in HP	Strategies for enhancing resilience in rain-fed agriculture	Drought preventive measures & Contingency Plan	Pest control measures in different crops

• Introduction
• Extreme weather events in Himachal Pradesh
  ▪ Flood
  ▪ Flash flood
  ▪ Glacial Lake Outburst Flood
  ▪ Drought
• Impact of climate change on natural hazards
• Major crops/ cropping systems in HP and impact of changing climatic and weather conditions
• Activity Sheet
S 1
	• Agro-ecological zones and vegetation types
	• Agro-climatic zones
	• Zonation based on horticulture resources
	S 2
		• Strategy: Using short duration/ pest resistant/ heat tolerant cultivars including crop varieties suitable for early, mid, late season drought
		• Strategy: Inter-cropping techniques for drought management in up- land of Himachal Pradesh
		  ▪ Objective of inter-cropping
		  ▪ Principles and type of inter-cropping
		  ▪ Advantages of inter-cropping
		• Case Study: Potato-French beans inter-cropping including field preparation, planting method, and spacing; fertilization, yield and economics of potato + French beans inter-cropping
		• Strategy: improved method for cultivation
		  ▪ SRI in irrigated areas
		S 3
			• Contingency plan for high hill temperate wet zone
			• Contingency plan for mid hills sub humid zone
			• Contingency plan for low hill and subtropical zone
			S 4
				• Insects
				• Diseases
				S 5

SESSION- 1 Weather events of Himachal Pradesh – Perspective building

OBJECTIVE

- To understand the extreme weather events caused by climate change
- To understand the impact of climate variability on different cropping system

FACILITATION

STEP 1 Introduce handouts through a power point presentation. This would include the objective of the session and process. The facilitator will take to deliver the session.

STEP 2 Emphasize the importance, to all participants, of having common understanding of weather patterns and its impact. Talk how weather pattern are changing. Involve participants what they think and get an idea of their perception.

STEP 3 Discuss how climate change impacts lead to increased risk of natural hazards in Himachal Pradesh.

STEP 4 Discuss about cropping patterns practiced by farmers. After brief discussion with the participants give them Activity Sheet SA-1 to fill. After 10 minutes, stop them and collect the sheets. Based on their answers, facilitate them with recommendations.

MATERIAL REQUIRED

PowerPoint presentation, relevant handouts, chart paper, markers, tape, Activity Sheet SA-1

TIME

20 Minutes

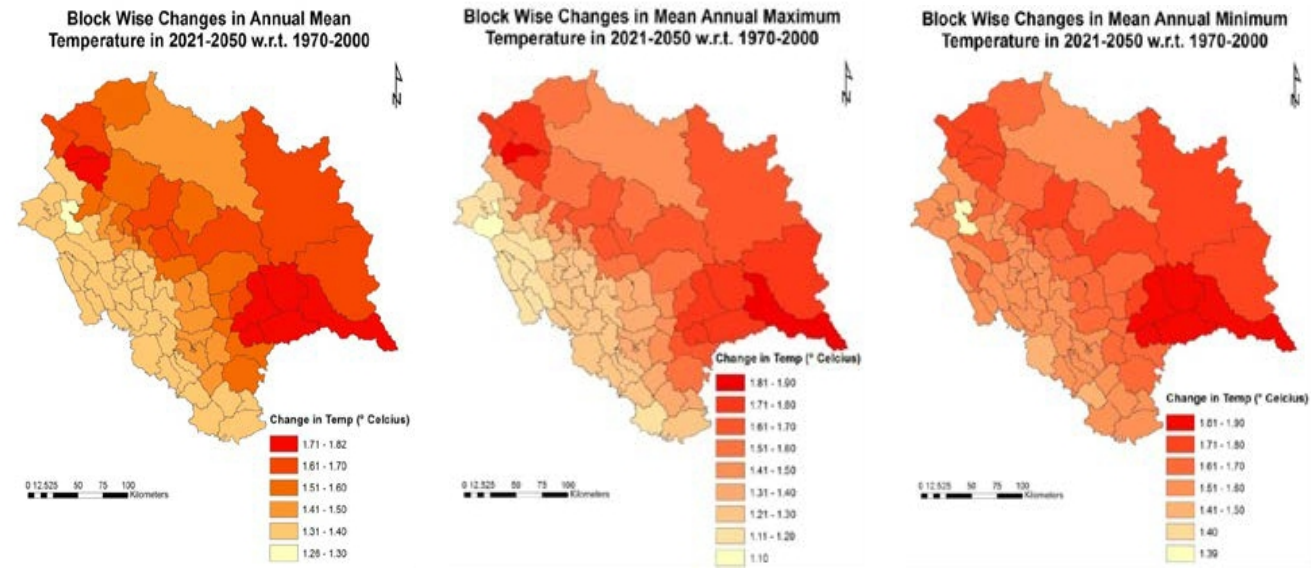
LEARNING FACTS

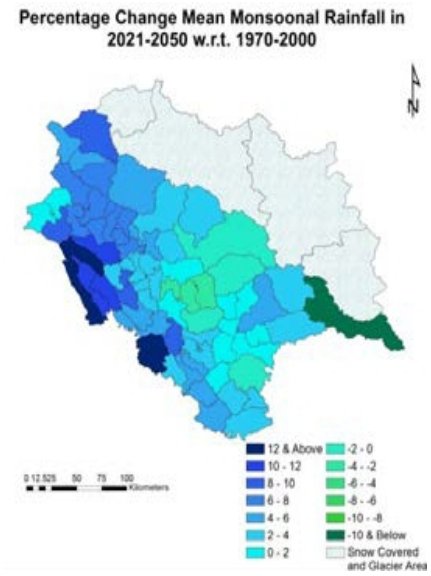
S 1

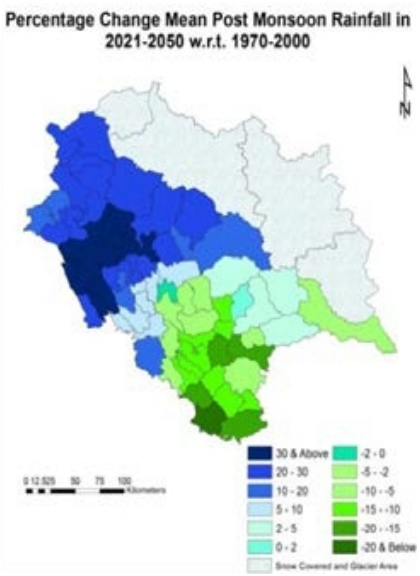
Agriculture is the largest occupation and source of livelihood, where **cultivation is mainly (80.9%) rain dependent**. The abnormal pattern of rainfall over the past few years has caused great fluctuations in crop production. The performance of crops is directly related to rainfall received during the crop season. The rainfall has shown variation in different districts, in some it was in excess whereas in others deficient. The State has primarily two cropping seasons: Kharif season (paddy & maize) and Rabi (wheat, barley).

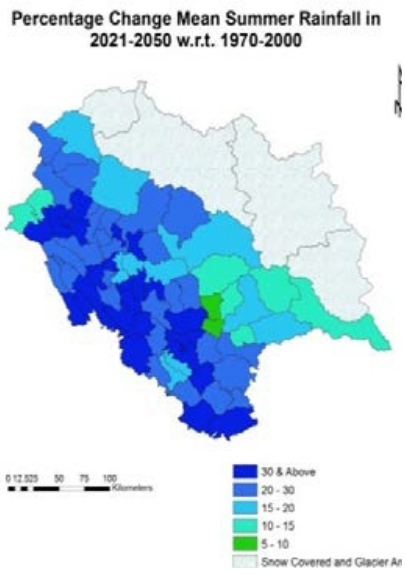
The scientific assessments based on temperature and rainfall data between 1951-2013 for the State obtained from India Meteorological Department (IMD) shows that average annual day-time temperature for Himachal Pradesh is about 26 C. (ranging between 24.5 and 27.10C) and the temperature (both annual day time average and night-time average) in the 63 years shows an increasing trend. It is further estimated through computer models that average annual minimum (night-time) **temperature will increase further in the range of 1.3 to 1.9 degrees C by 2050**.

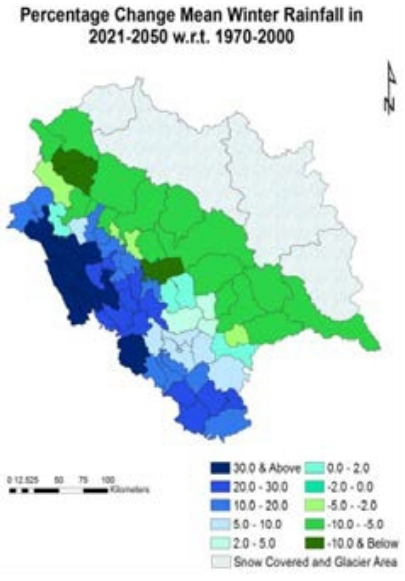
Observations related to rainfall shows average annual rainfall of Himachal Pradesh to be about 1284mm (ranging from 704.7 to 2062.8 mm). The south west monsoon (JJAS months: June-July-Aug-Sept) rainfall contributes more than 65% to the annual rainfall. Overall assessment over past 60 shows a declining trend in annual rainfall indicating that the total amount of rainfall and the number of rainy days received by the state have declined since 1951. The annual average rainfall over the state of Himachal Pradesh for the period 1951-2010 indicates a decreasing trend (-3.26 mm/yr). It is concluded that the implications of such climatic events may include heat stress related health impacts, increase in energy demand for cooling, additional evaporation and evapo-transpiration losses resulting in enhanced irrigation water requirement for crops and loss of soil moisture. Increase in intensity of rainfall events may lead to floods, increase soil erosion and loss of fertile soil, increase in vector borne diseases and crop pests, loss of work, transport disruption, additional cost for flood proofing factories and warehouses pushing the state to a situation of more vulnerable due to climate change impacts especially for water, agriculture and allied sectors.











On the other end the state is having an agrarian economy where Agriculture provides direct employment to about 62 percent of the total workers of the state and the **agriculture and its allied sector contribute about 10 percent of the total GSDP of state**. Rural population has high dependence on agriculture, 62.85 % of the total working population is engaged in agriculture and 70% in rain fed agriculture. The average cultivated land in the state is about 6.2 lac hectare out of which 80% is rain-fed agriculture. Horticulture is also practiced in the state with total cultivable area of 6.15 Lac Ha. In the state each agro-climatic zone has potential for growth of varied crops. Agro-climatically the region is more suitable for growing off-season vegetables and temperate fruits which have proved economic prosperity of farmers as well.

However, the state has a high reliance on agriculture which has a direct bearing from climate variations. **Climate**

change poses additional challenges in the sector as higher temperatures increase and decrease rain fall leads to need for water, irrigation and the risk of warm stress on crops. It is anticipated that there may be an all-round decrease in horticultural-agricultural production in the region in long-term, and the line of production may shift to higher altitudes. Apple production in the Himachal Pradesh region is reported has decreased between 1982 and 2005 as the increase in maximum temperature has led to a reduction in total cumulative hours in the region-a decline of more than 9.1 units per year in last 23 years. Further, Temperature Humidity Index (THI) of the state is projected to rise in many parts of State during March–September with a maximum rise during April–July in 2030s with respect to 1970s and that again will lead to put negative impact on the livestock productivity of the state. Thus **Climate change in the state is already affecting the food security**, water security, food production systems, supply chains and livelihoods. It is envisaged that by end of the century, climate change may cause significant increases in inter-annual and intra-seasonal variability of monsoon rainfall.

Extreme weather events in Himachal Pradesh

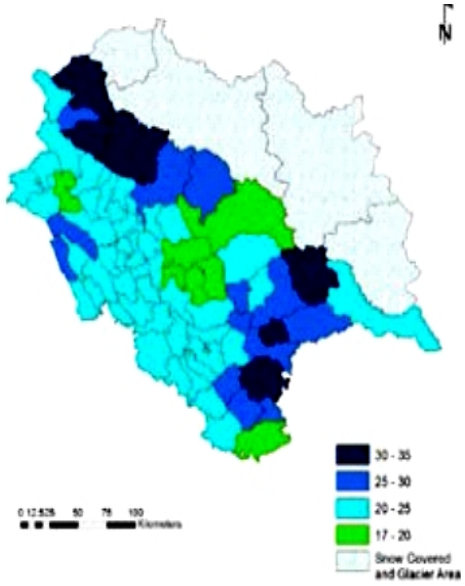
FLOOD

Although Himachal Pradesh is at the tail end of the southwest monsoon track, it receives considerable rainfall during the months of July to September. This coupled with snowmelts in high altitudes cause the rivers to swell, sometimes much beyond their capacities to drain out, resulting in floods in low lying settlements. In exceptional circumstances, riverine floods may also occur due to outbursts of dam created temporarily on rivers due to landslides. Two rivers that face flood almost every year are Sutlej and Beas. Unlike in the plain areas, riverine floods of Himachal Pradesh are temporary as the overflow is drained out quickly due to the sloppy terrains. But this leads to damage of fertile agriculture and horticulture land and trees due to erosion. Water harvesting structures, hydropower infrastructure of both mega and micro-hydel projects are also at risk. Such **floods have inflicted considerable damages to life and property** in the State and in some years the extent of damages have been considerable. Loss to agriculture in terms of areas and value of crop has been increasing every year - from 46 crore in the year 2000 to 417 crore in the year 2011.

FLASH FLOODS

Flashfloods are more frequent and damaging in Himachal Pradesh than riverine flood. Flash floods may occur even in small rivulets or streams when there are excessive rains, cloudbursts or other disturbances in the upper catchment areas. **Such floods may occur with little or no warning** and may cause immense damage and loss to life and property. The major causes for flash floods in Himachal Pradesh are:

- Cloudburst in upper catchments of the river
- Excessive rainfall in the catchments
- Melting and bursting of glaciers due to rising temperature
- Landslides triggered due to slope failure or tectonic movements
- Sudden breach or failure of manmade or natural barriers
- Change of river course



Precipitation percentages due to extreme rainfall

GLACIAL LAKE OUTBURST FLOODS

The Himalayan region has about 15,000 glaciers which is nature's renewable store house of fresh water. In the face of accelerated global warming the glaciers in the Himalayan region are retreating/ melting at a high rate of 30-60 metres per decade leading to accumulation of increasing amounts of water in mountain-top lakes. Such lakes are formed behind moraine or ice 'dams'. Satellite observation of the mountain top lakes in the region have revealed a steady increase in the size and volume of many of these glacial lakes at high altitudes. Due to the inherent instability of such 'glacial lakes', the potential of sudden outbursts/ breaches is extremely high. Such outbursts can lead to a discharge of millions of cubic metres of water and debris in a few hours which can cause catastrophic devastation and flooding up to hundreds of kilometres downstream. This phenomenon constituting a sudden discharge of a huge volume of water from such glacial lakes is known as Glacial Lake Outburst Flood (GLOF). Such flooding can lead to serious damage to life, property, agriculture, livestock, forests and ecosystems. The livelihoods of mountain dwelling communities are heavily dependent on mountain ecosystems for sustenance, as well as precious socio-economic infrastructure and assets like hydro-power, electricity, communications, roads and bridges. All of these can induce forced migration and undermine the already meagre sources of livelihood of mountain communities. **Himachal Pradesh has 2,554 glaciers with 229 glacial lakes, 22 of them being potentially dangerous.**

DROUGHT

Meteorologically, drought is defined as a situation when the annual rainfall over any area is less than 75 percent of the normal. It is termed as moderate if rainfall deficit is between 25 to 50 percent and severe if the deficit is more than 50 percent. Himachal Pradesh is enlisted under the frequent drought (10-20% probability) prone areas as per Indian Meteorological Department's (IMD) classification of drought incidences from 1875-2004 period. **A total of 23 droughts have occurred in the state of which 20 were moderate and 3 have been severe** over the 1879-2009 time period with the drought probability of 17 % and with four instances of consecutive droughts over two years. With rainfall projected to be more erratic and long period of dry days, the State is expected to face more drought like situations.

CLIMATE FACTS

Impact of Climate Change on Natural Hazards

Climate change impacts most of the natural hazards of Himachal Pradesh, in particular the hydro-meteorological hazards. Various studies have indicated that patterns of temperature and rainfall are changing in the Himalayan State and these are likely to increase the frequency and intensity of extreme climatic events, such as riverine and flash floods, drought, avalanche, cloud bursts, landslide, forest fires etc. while unfamiliar events such as GLOFs may take place disrupting normal life and economy of the State.

The Himachal Pradesh State Action Plan on Climate Change has identified the following trends of climate change and their impact in the State:

- Average mean surface temperature of the State has risen by about 1.6°C in the last century.
- Warming rate of Shimla was higher during the past two decades as compared to earlier decades.
- About 17 percent decrease in rainfall in Shimla was observed from 1996 onwards. The decreasing trend in seasonal snowfall in Shimla is conspicuous since 1990.
- Monsoon discharge in Beas River has shown a significant decrease.
- Winter discharge in River Chenab has shown a significant increase.
- River Satluj shows an increasing trend in winter and spring discharge.
- The glacial deposits in the State are declining. The glaciers in Chenab, Parbati and Baspa basins have retreated from 2,077 to 1,628 sq. km.
- Quality of apple has been affected and the apple line has shifted upwards. Area under apple orchards is being diverted to vegetable cultivation due to rising temperature.
- Incidence of pest and disease are becoming more severe.

The State Action Plan has projected that south-eastern parts of the State would be facing moderate to extreme drought like conditions, while incidence of floods and flash floods would increase in the north- wester areas. Retreating glaciers would create new risks of GLOF in the alpine regions, while **rising temperature would exacerbate the existing risks of forest fires** in the Shivalik and mid-mountainous regions.

Major crops/cropping patterns in Himachal Pradesh and impact of climate change

AGRICULTURE CROPS		HORTICULTURE CROPS	
Kharif Crops (June-September)	**Rabi Crops (October-May)**	**Rainy Season (June-Sepetember)**	**Winter Season (October-May)**
Maize, Paddy, Pulses (Mash, Kulth, Mung, Rajmah, Arhar, Urd) Millet Sugarcane, Sorghum (Johar) Ginger, Turmeric, Black gram, Toria, Pumpkin, Cucumber, Lauki, Capsicum, Tomato	Wheat, Barley, Gram Lantil, Mustard (Oil Seed), Cauliflower, Tori, French Beans, Potato, Pea, Garlic.	Mango, Peach, Lime, Plum, Apple, Guava, Papaya, Citrus Fruit, Banana.	Apple, apricot, pear, peach, Walnut

However deficit and erratic rainfall; high dependence on monsoon and least diversification of crops/ livelihood options; lack of rain water harvesting culture; lack of reservoirs/check dams for conservation of water; high poverty has pushed the farmers from the district especially small and marginal land holders to margin. To enhance adaptive capacity and enhance resilience of the farming community to climate variability thus has to focus on climate resilient agriculture which entails appropriate strategies to contingent situations as well as addressing challenges arising out of long term climatic changes. In this context, climate resilient crop varieties are one the most important resources. Improved and tolerant varieties along with the proper management practices can enhance the coping ability through risk reduction in vulnerable conditions.

Accordingly, this module consists of discussion of various potential climate conditions due to climate change impact; introducing drought/temperature tolerant varieties, advancement of planting dates of Rabi crops in areas with terminal heat stress, water saving paddy cultivation methods, drought resilient cultivars; community nurseries in multiple dates for delayed monsoon, farm machinery custom hiring centres for timely completion of farm operations, location specific inter-cropping systems with high sustainable yield index.

Various cropping patterns being practiced in Himachal Pradesh

Paddy – Wheat	Mash – Wheat
Maize – Wheat	Ginger – Potato
Maize – Toria – Wheat	Maize – Peas/Bean+Potato
Maize+Mash – Barley/Garlic	Tomato/Capsicum – Wheat

DISCUSSION POINT

Impact of climatic variability on above mentioned cropping pattern/cycle under different potential scenarios

CLIMATE CONDITIONS	IMPACT
Delayed onset of summer • Delayed by 2 weeks • Delayed by 4 weeks • Delayed by 6-8 weeks	• Shift in sowing time and shorter growing • Reduced number of rainy days • Requires adjustment in sowing and harvesting dates
Mid-season drought (long dry spell, consecutive 2 weeks rainless period) • When the crop/ plant is growing stage • At flowering/ fruiting stage	• Decrease in water availability at critical growth stages • Inadequate soil moisture availability
Terminal drought (Early withdrawal of monsoon)	• High yield loss in case of food crops such as rice, wheat. • Unfilled grains
Decrease in scattered spell of light rainfall and an increase in short spells of intense rainfall leading to.	• Reduced percolation and aquifer recharge • Flash flood and increased soil erosion
Delayed onset of winter monsoon • Delayed by 2 weeks • Delayed by 4 weeks • Delayed by 6-8 weeks	• Shift in sowing time and shorter growing • Reduced number or absence of rainy days • Requires adjustment in sowing and harvesting dates
Decrease in or lack of winter rains especially during January to June period.	• Reduced water availability affecting off-season cultivation of vegetables
Increase in maximum temperature up to 1° C especially winter temperature.	• Depleted soil moisture • Decline in wheat and potato yield • Forced maturity, unfilled grains • Increase in pests and disease

ACTIVITY SHEET

SA 1

➔ What are the main agriculture and horticulture crops in your area/village?

➔ What are the cropping patterns you follow?

➔ What kind of weather pattern you experienced in past 5-10 years?

SESSION- 2 Agro-ecological zones and stress tolerant crop varieties

OBJECTIVE

- To understand the different agro-ecological zones in Himachal Pradesh
- To understand the zonation based on horticulture resources
- To have better understanding of the pest resistant/heat tolerant cultivars

FACILITATION

STEP 1 Introduce handouts through an organized power point presentation. This would include the objective of the session and the process the facilitator will take to deliver the session. Emphasize the importance of all participants having common understanding of weather patterns and its impact.

STEP 2 Explain what are the agro ecological zones. What are the parameters to divide them into different climatic zones.

STEP 3 Talk about the horticulture resources. What they understand about agro-climatic zone. Involve participants what they think and get an idea what their knowledge is.

STEP 4 Discuss and explain about the important crop varieties suitable for early season, mid season and late season drought. Involve participants to share their experiences about these varieties.

MATERIAL REQUIRED

PowerPoint presentation, relevant handouts, chart paper, markers, tape

TIME

15 Minutes

LEARNING FACTS

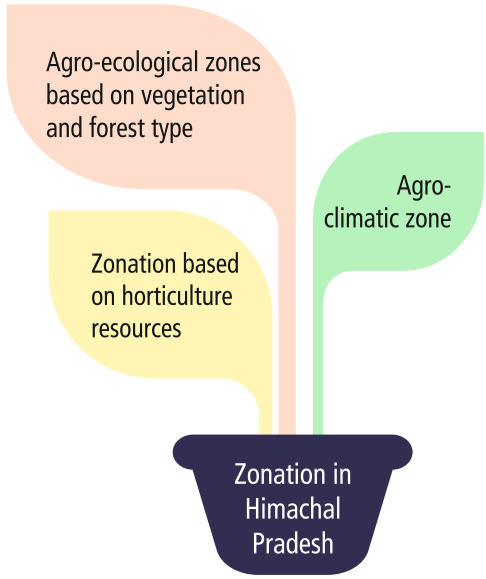
S 2

Different zonations of Himachal Pradesh

1. Agro-ecological Zones and Vegetation Types:

The State of Himachal Pradesh has been divided into four agro-ecological zones based on altitudes, which are associated with different forest types each having trees, shrubs and herbs species. These are:

- **Sub-tropical zone**, comprising low hills up to 1000m
- **Sub-tropical zone**, covering mid-hills between 1000m to1500m.
- **Temperate wet zone,** representing high hills between 1500m to 3000m
- **Temperate dry zone,** representing high hills above 3000m (Alpine pasture)

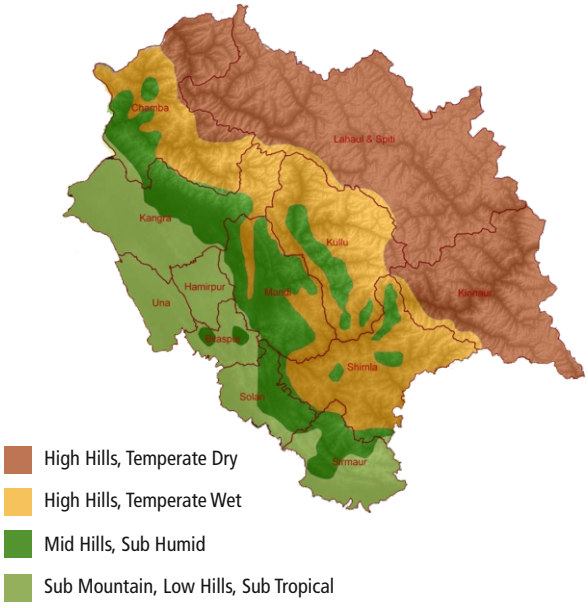


2. Agro-climatic Zones:

The **State has been divided into four zones keeping in view the altitude, rainfall, temperature, humidity and topography**. While maximum geographical area of the State falls under high hills and temperate dry zone (Zone-IV), the highest percentage of cropped area is in the mid hills and sub-humid zone (Zone-II). Likewise, the maximum precipitation is experienced in Zone II which ranges from 1,500 to 3,000 mm per annum.

- **Sub-Montane and Low Hills Subtropical Zone (Zone-I):** The soils of this zone are productive, if fertilized. The texture of the soil varies from loamy to sandy loam. The average rainfall is 1100 mm of which 80% is received during July to September. The farming is rain fed as only 16.6% of the total area is under irrigation.
- **Mid-hills Sub-humid Zone (Zone-II):** The texture of the soils in Zone II is loam to clay loam. These are deficient in nitrogen and phosphorus and have poor water and nutrient holding capacity. The area from Dharamshala to Jogindernagar in the foothills of Dhauladhar ranges receives rainfall as high as 3,000 mm most of which comes between mid June to mid September. In the remaining areas, it is around 1,500 mm. While maize, rice, wheat, potato, pulses and oilseeds are major field crops, stone and citrus fruits are important fruit crops.

Agro-climate Zonation of Himachal Pradesh



The **area under irrigation is only 17.5%** and kuhls (gravitational flow channels) are the important source of irrigation.

- **Mid-hills Temperate Dry Zone (Zone-III):** The soils of this zone are shallow in depth, acidic in reaction and silt loam to loam in texture. These are deficient in nitrogen and phosphorus. The average rainfall is 1,000 mm most of which is received during the monsoon season. The **zone is suitable for growing horticultural crops**, particularly apple, plum and apricot. Cultivation of off-season vegetable crops like peas, cabbage, cauliflower and tomato has gained ground in some areas.
- **High Hills Temperate Dry Zone (Zone-IV):** The soils of this zone are mainly sandy loam, neutral to alkaline in reaction and have low fertility. This **zone has the highest percent of irrigated area (40.6%)**. The important crops include potato, barley, buck wheat, peas and minor millets. The area is particularly suitable for growing off-season vegetables and seed production. In general, only one crop can be grown during the whole of the agricultural year because of heavy snowfall in winter from November to April.

3. Zonation based on Horticulture resources:

From the Horticulture resources point of view, the State has been divided into 4 zones namely:

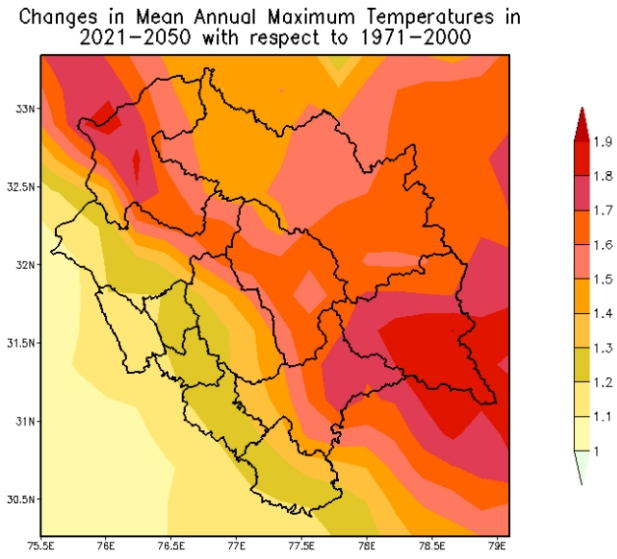
- **Low Hill and Valley areas near the plains**
- **Mid Hills (Sub Temperate)**
- **High Hills and Valleys in the interiors (Temperate)**
- **Cold and Dry Zone (Dry Temperate)**

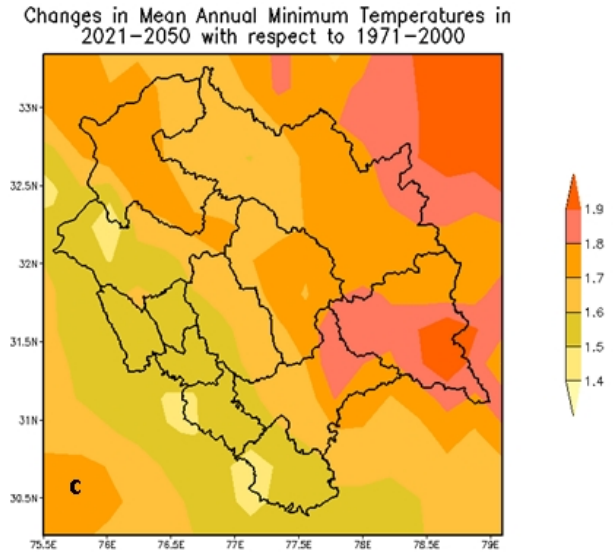
DISCUSSION POINT

The table below shows average rain fall based on the historical data. Is it still valid in this changing climate? Let's check out with participants.

Horticultural Resources (crops) and Zones in Himachal Pradesh

S. No.	Zone Description	Elevation Range (amsl)	Rainfall (cms)	Suitable Fruit Crops
1.	Low Hill and Valley areas near the plains	365 - 914	60 - 100	Mango, Litchi, Guava, Loquat, Citrus Fig, Ber, Papaya, Early varieties of Grapes, Jack Fruit, Banana, Low chilling varieties of Peach, Plum and Pear, Strawberry
2.	Mid Hills (Sub Temperate)	915 - 1523	90 - 100	Stone Fruits (Peach, Plum, Apricot, Almond), Persimmon, Pear, Pomegranate, Pecan nut, Walnut, Kiwi Fruit, Strawberry
3.	High Hills and Valleys in the interiors	1524 - 2742	90 - 100	Apple, Pear (Soft), Cherry, Almond, Walnut, Chestnut, Hazel-nut, Strawberry
4.	Cold and Dry Zone (Dry Temperate)	1524 - 2656	24 - 40	Apples, Prunes, Drying type of Apricot, Almond, Chilgoza, Pistachio nut, Walnut, Hazel-nut, Grapes and Hops





The above model projection shows increase in temperature extreme in Himachal Pradesh which will mostly witness in zone II and III region highly significant for agriculture and horticulture in the state. The increase in temperature will be coupled with increase in extreme rainfall events with few number of overall rainy days. This will require an incremental shift towards use of stress tolerant crop varieties.

SESSION- 3 Strategies for enhancing resilience in rain-fed agriculture in Himachal Pradesh

OBJECTIVE

- To have better understanding towards strategies for rain fed agriculture
- To understand the Inter-cropping techniques for drought management
- To have better understanding of type and advantage of Inter-cropping
- To understand improved method of cultivation

FACILITATION

STEP 1 Introduce handouts through an organized PowerPoint presentation. This would Include the objective of the session and the process the facilitator will take to deliver the session. Emphasize the importance of all participants having common understanding of weather patterns and its impact.

STEP 2 Session will start with explaining about drought resilient varieties and cropping pattern and how these helps. What are various kind of climate stresses.

STEP 3 Facilitator will describe further about different types of inter cropping techniques for drought management and its advantages. Visual examples will be given with PowerPoint presentation.

STEP 4 Case in Point: Potato-French bean inter-cropping will be discussed and explained in detail. Then it will graduate to other improved method of cultivation and examples.

STEP 5 In the last facilitator will show few short clips related to the session components to give better understanding to the participants.

MATERIAL REQUIRED

PowerPoint presentation, relevant handouts, chart paper, markers, tape, projector to play videos

TIME

30 Minutes

LEARNING FACTS

S 3

Strategies for enhancing resilience in rain-fed agriculture in Himachal Pradesh

What are the drought resilient varieties and cropping pattern and how these helps?

Identification and use of climate resilient crop varieties and making cropping pattern climate resilient, with enhanced tolerance to heat, drought, flooding, chilling and disease/ pest are essential to sustain and improve crop yields to cope with the challenges of climate change. Adverse environmental/ climatic conditions discussed above have potential to negatively affect our crops and drastically reduce yields. To able to identify and se climate resilient cultivars and cropping methods, it is essential to identify the traits that maintain and promote the growth and yield of a particular crop in specific agro-climatic zone. Accordingly, this session will deal with various climatic stresses and popular cultivars available as well as cropping methods and practices to enhance resilience to climatic changes.

STRATEGY 1

Using short duration/ pest resistant/ heat tolerant cultivars including Crop Varieties suitable for Early Season, Mid-Season, Late season drought

Crop	Variety	Year of Release	Cultivation Conditions	Climate-relevant features
Wheat	DBW173	2018	Irrigated Late sown (December)	• High yielding variety (>45 q/ha, average yield) • Tolerant to terminal heat stress hence, suitable for late sown conditions • Resistant to yellow rust (most of the prevalent races) and karnal bunt • High protein content (~12.5%) • Good nutritional quality • Excellent chapati-making features
Wheat	Raj 3777		Suitable for late sown and rain-fed, irrigated conditions	• Resistant to karnal bunt. • Average yield of 41-45 qtls/ha • Medium term (131-143 days to mature). • Very good for bread making; protein content 12-13%
Wheat	HS 295		Suitable for timely sown and restricted irrigation, rain-fed conditions	• Average yield of 21-25 qtls/ha • Early maturity (126-134 days to mature) • Protein content 12-13%
Wheat	PBW 343		Suitable for timely sown and irrigated conditions	• Resistant to stripe rust (yellow rust), leaf rust (brown rust), karnal bunt • Early maturity (126-134 days to mature)
Wheat	PBW 502		Timely sown and irrigated conditions	• Early maturity (126-134 days to mature) • Resistant to karnal bunt (care should be taken to save it from loose smut) • Protein content is 12-13%

Wheat	HPW236		Suitable for late sown and rain-fed, irrigated conditions	• Drought stress • Resistant to yellow rust and other diseases
Rice	VL Dhan 221		Timely sown under rain-fed condition	• Suitable under drought stress in rain-fed areas
Toria	Bhawani			• Suitable under drought stress
Rice	ARIZE 6129, PAC807		Cultivation under delayed monsoon	• Suitable under drought stress in rain-fed areas
Maize	Bajaura Makka		Cultivation under delayed monsoon	• Suitable under drought stress in rain-fed areas

DISCUSSION POINT

What are the cultivars participants use for Horticulture and Agriculture crops in their areas?

What are the benefits you experience using these cultivars?

STRATEGY 2

Inter-cropping techniques for drought management in up-land of Himachal Pradesh

Growing of two or more crops simultaneously on the same piece of farm land. Inter-cropping has been recognized as a potentially beneficial system of crop production and evidences suggest that it can provide substantial yield advantage over sole cropping, not by costly inputs but by a simple expedient of growing crops and this system also plays an important role in subsistence food production in both developed and developing countries, especially in situations of limited water resources. Thus **inter-cropping acts as an insurance against hazards of weather, guards against crop failure** by disease or insect-pest incidence, ensures efficient utilization of land and other resources. Under conditions of erratic rainfall versatility of grain legume and non-legume in mixture especially soybean, urd, moong, pigeonpea, rajmah and non-legumes like Brassica spp. and linseed can be exploited for obtaining higher yields per unit area per unit time because of their consistently good performance over a wide range of climatic and soil conditions. Mixed cropping is traditionally defined as a system of growing two or more than two crops in the same ground area without any row arrangement, while inter-cropping implies the growing of two or more crops simultaneously in the same ground area in rows of definite geometric pattern.

OBJECTIVES OF INTERCROPPING

- Protection against main crop failure under erratic weather conditions or pest epidemics.
- Increase in total productivity per unit of land area.
- Judicious utilization of resources such as land, labour and irrigation water, fertilizer etc.

PRINCIPLES OF INTERCROPPING

- The time of peak nutrient demands of component crops should not overleap.
- Competition for light should be minimum among the component crops.
- Complementary should exist between the component crops.
- The differences in maturity of component crops should be at least 30 days.

TYPES OF INTERCROPPING

Intercropping Type	Example	Cropping System	Photo
Mixed Intercropping Growing two or more crops simultaneously with no distinct row arrangement	Legume (pea, French bean) inter-cropping with potato	Maize–Pea/ Bean+Potato	 Intercropping of beans and potato
Row Intercropping Growing two or more crops simultaneously where one or more crops are planted in rows	Intercropping of maize and pulses by planting two rows of pulses for each row of maize	Maize-pulses system	 Row intercropping of maize and pulses
	Intercropping of maize and gobhi	Maize-gobhi system	 Row intercropping of maize and gobhi
Relay Intercropping Growing two or more crops simultaneously where second crop is planted after flowering of the standing crop but before it is ready for harvest.	Intercropping with wheat and soybean	Rice-wheat system	 Relay intercropping wheat and soyabean

ADVANTAGE OF INTERCROPPING SYSTEM

The advantages of intercropping are well recognized in India and especially in regions where the holdings are very small to medium and the land under cultivation is limited. **Intercropping allows complimentary use of available resources like water, space, light and nutrients** for conversion to biomass more efficiently as a result of difference in competitive ability of different intercrops for these resources. This efficient utilization of resources leads to yield advantage and gives increased yield stability as compared to sole cropping of the component crops.

- Intercropping gives additional yield and income/unit area than sole cropping.
- It acts as an insurance against failure of crops in abnormal year.
- Inter-crops maintain the soil fertility as the nutrient uptake is made from both layers of soil.
- Intercrops provide shade and support to the other crop.
- Better control of weeds.
- Inter cropping system utilizes resources efficiently and their productivity is increased.
- Reduction in soil runoff.
- Intercropping with cash crops is highly profitable.
- It helps to avoid inter-crop competition and thus a higher number of crop plants are grown per unit area.
- Reducing the incidence of insects, pests and diseases.

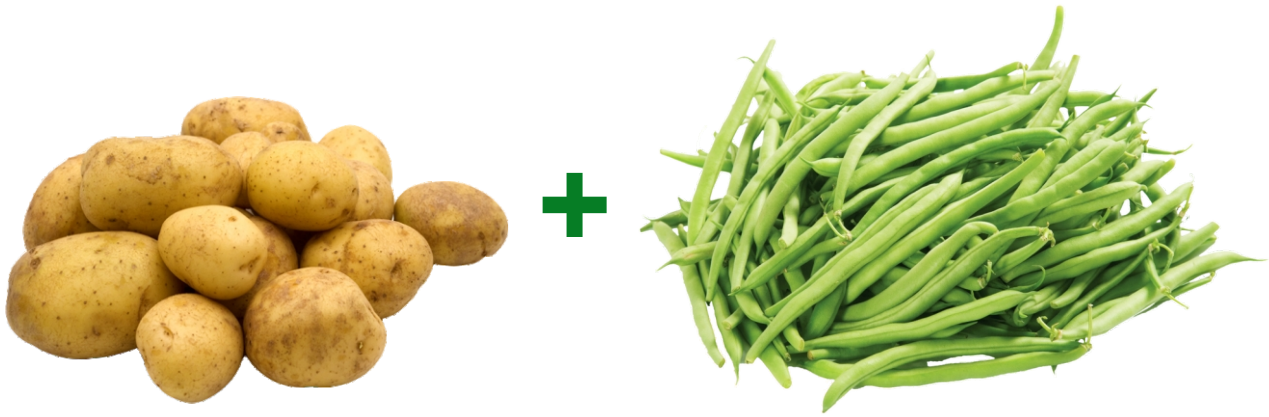
SOME IMPORTANT INTERCROPPING SYSTEMS

- **Rice:** Rice in puddeled conditions, intercropped with other varieties of rice. In upland cultivation with, Jowar, Maize, Soybean and Pigeon pea
- **Maize:** with Soybean, Mash, Moong, Cowpea, Arhar etc.
- **Wheat:** with gram, Lentil, Rai, Pea, Sarson, Rapeseed, Linseed.
- **Sugarcane:** with Potato, Wheat, Arhar, Moong, Mash, Cowpea and fodder crops like Cowpea.

CASE STUDY

Case in Point: Potato-French bean intercropping

Potato crop produces higher dry matter per unit area and its cropping season in the State offers excellent opportunity for intercropping. It is also a high value cash crop and thus enhances profitability of the system. Potato crop fits well in different multiple and intercropping systems.



However, some minor adjustments are needed in production technology to make potato-based cropping system profitable. Studies have shown that, in the Shimla hills region, the growing season can be better utilized by intercropping of potato (Solanum tuberosum L.) and French bean (Phaseolus vulgaris L.), which not only gives yield advantage but also provides protection against unpredictable weather that sometimes cause heavy loss. This may be due to late blight and other pest and disease in potato crop. Maximum advantage from potato and French bean intercropping is obtained when they are planted in 2:2 row ratio with 2 rows of potato at 60 cm planted between 2 paired rows of French bean (30/120 cm). However, the nutrient requirement of French bean is different.

VARIETIES AND FIELD PREPARATION

- Mostly *Kufri Jyoti* and *Kufri Giriraj* are most suitable for intercropping. French bean varieties used in the system are mostly high yielder or hybrids like Contender. Intercropping of French bean in potato is being grown in most of the area in the mid hills of north western Himalayas of Himachal Pradesh and in a wide range of soils. However, the best yield of potato and French bean has been obtained in sandy loam in texture with well drained soils.
- Select a field which should have approximately 5-10% slope. After harvesting the previous year crop, plough the field with desi plough and keep the soil exposed so that it may absorb moisture/ rains/ snow during winters.
- After melting of snow, level the field by planking in order to conserve moisture in the soil which is required for proper germination. Remove ground keepers or volunteer if any which are unpicked potato tubers left over from previous crop of potato. Lastly, plough the field twice or thrice with desi plough followed by planking before planting potato.

PLANTING METHOD, SEED RATE AND SPACING

- Potato + French bean (2:2) intercropping system, in which two rows of French bean (paired at 30 cm) were planted after every two rows of potato planted at 60 cm i.e. every third row of potato was replaced with a paired row of French bean sown at 30 cm row spacing as per given in the figure.
- Seed rate is 30-40 q/ha and spacing is 60 x 20 cm (row x plant). Make furrows across the slopes at 60 cm distance between the rows. Making the furrow against the slope and not along the slope is necessary to avoid soil erosion and conserve more moisture in the soil during less rain situation.
- Make 4-5 m wide beds providing a drainage channel between beds to drain out excess rain water during heavy rain season. Apply FYM and basal dose of NPK fertilizer mixture in furrows and mix in soil with Khilna (hand tool) to avoid direct contact of fertilizer mixture with tubers and otherwise plant emergence may be affected or less.
- Planting of potato is done manually after fertilizer is placed in shallow furrow. Tuber is either placed in fertilized furrow then ridges are formed or tuber is dibbled in already made ridges after fertilizer applications. Plant small seed tubers < 25 g at 60x15 cm; 25-60 g tubers at 60x20 cm; 60-100 g tubers at 60x25 cm and > 100 g tubers at 60x30 cm spacing to control the seed rate. Avoid the use of cut tubers.
- Tubers are covered immediately after planting of potato by making small ridges of 10-15 cm height over the furrows. At equal seed rate cut tubers do not give yield as whole tubers. This may be due to the fact that cut tubers perpetuate certain diseases and rottage leading to poor emergence resulting low yield of potato.
- Nutrients are applied to component crops on the basis of proportion of sole crop population in intercropping i.e. since the 67% of the sole crop population of potato is maintained in inter cropping; potato is given 100% of the nutrients recommended for its sole cropping.
- Similarly, 50% of sole crop population is maintained in inter cropping of French bean sown at 15 and 10 cm plant spacing, respectively, therefore 50% of the sole crop recommendation is considered the full recommended dose in these situations.
- Planting of potato and French bean is done in the second fortnight of April or within 20 days of potato planting. Both the crops were raised with standard package of practices.

FERTILIZATION & MANURING IN POTATO + FRENCH BEAN INTERCROPPING

- Potato as well as French bean is very nutrient exhaustive crop, therefore, to get better production and profitable return from the intercropping, efficient management of nutrients is required.
- Normal recommended dose for potato and French bean in this region is 120:100:100 and 50:100:100 kg/ha for N:P:K, respectively.
- Normally nitrogen is applied in split doses first as basal and another at earthing up of potato (after about 30-40 days of planting when crop will attain the 10-15 cm height).
- Phosphorus and potassium application is done normally as basal at the time of potato planting at the rate of 100 kg /ha each nutrients.
- Application of farmyard manure (FYM) @ 30 t/h has been found beneficial. If available, apply half of the FYM immediately after harvesting the previous year crop and remaining half at planting of the current year crop.

INTERCULTURE

- Weeding and hoeing should be done when potato and French been plants attain 10-15 cm height at about 20-30 days after planting followed by earthing up at 30-40 days after planting.

HARVESTING AND MARKETING

- Potato is harvested during mid-September, whereas, picking of French bean pods is done twice or thrice during June to September. Dig potato tubers in last week of August for immediate sale as the skin is immature and it cannot be stored. However, if the harvesting is delayed for any reason or in certain other sequential and intercropping systems and the skin is hard and mature tubers may be stored by March.
- Potato varieties used in the system mostly take 100-120 days to attain maturity. Therefore, potato harvesting is done manually, by the end of August to September. French bean increase not only nitrogen supply through atmospheric N fixation but also improves over all soil health.

YIELD

- Yields of potato and French bean based on research conducted by CPRI, Shimla in the region vary widely and ranges from 200-250 and 110 q/ha, respectively as a sole crop.
- Yield advantage in intercropping occurs because component crops (viz., potato and French bean) differ in their use of growth resources in such a way that when they are grown in combination they are able to complement each other and so make better use of resources than grown as sole crops.
- Intercropping of French bean in potato according to farmers increase yield of potato 15-20 per cent on area basis and similarly, there is some reduction in yield of potato and yield of intercropped French bean as compared to pure potato and French bean. If population of potato is maintained 100% by reducing plant to plant spacing (13X13 cm). There was no significant reduction in yield of potato and French bean in the intercropping.
- French bean adds nitrogen by fixing atmospheric nitrogen in root zone and it act as a green manure. On an average the potato yield in the intercropping ranges from 190200 q/ha and the French bean yield 60-80 q/ha.

ECONOMICS OF POTATO + FRENCH BEAN INTERCROPPING

- For intercropping, the cost of cultivation is around also Rs. 55-60 thousand /hectare. The gross return from the intercropping system of potato+ French bean comes around Rs. 67250/ per hectare, which is about Rs 15000/- more on an average from pure potato crop and from pure French Bean.

STRATEGY 3 | **Improved method for cultivation**

SYSTEM OF RICE INTENSIFICATION (SRI) IN IRRIGATED AREAS

SRI is in fact a package of practices especially developed to improve the production of rice with less water. These can be explained through following steps:

NOTE

To scan the given QR codes and quickly go to the video, please install 'QR & Barcode Scanner' App in your Smartphone.

STEP 1 Selection and preparation of quality viable seeds

VIDEO (IN HINDI)

SCAN TO WATCH VIDEO

Video Link: goo.gl/dzKwYB

STEP 2 Nursery plot preparation and management

- Preparing nursery 2 weeks before sowing date
- 6 raised beds of (1m x 6m) for seedlings for one-acre field with about 3-4 kg seeds
- Cover the bed with straw to prevent it from direct sun light and birds' infestations; Apply water to maintain soil moisture;
- Remove the straw once the seeds have germinated.

VIDEO (IN HINDI)

SCAN TO WATCH VIDEO

Video Link: goo.gl/x13Fp4

STEP 3 Land preparation

- Level the field properly; use appropriate amount of organic fertilizers (manure) or chemical fertilizers;
- For easy management of water, create ditches in the field to help drainage;
- Divide the field using grids (25 X 25 cm spacing); A wooden or metal frame is easier to use and gives better results in terms of straight lines;
- With wider spacing and a single plant per hill, plants get increased exposure to sunlight, air and nutrients
- During grid making, the field should not have much standing water.

VIDEO (IN HINDI)

SCAN TO WATCH VIDEO

Video Link: goo.gl/rHYEim

Land Preparation

VIDEO (IN HINDI)

SCAN TO WATCH VIDEO

Video Link: goo.gl/B2zrvB

Marking

STEP 4 Transplanting

- Transplant at the age of 8-14 days when the seedlings have two leaves;
- Plant one seedling per hill on the grid intersections marked on the field;
- Plant seedlings at shallow depth, just 1 – 2 cm deep;
- Slip the seedlings into the soil sideways so that the roots stay horizontally into the soil.

VIDEO (IN HINDI)

SCAN TO WATCH VIDEO

Video Link: goo.gl/NoCENP

VIDEO (IN HINDI)

SCAN TO WATCH VIDEO

Video Link: goo.gl/aJagw1

STEP 5 Wetting and drying of the field

- Wetting and drying the fields use less water and improve soil aeration and promote roots elongation that allow more tillering and rapid growth of paddy plants.
- Follow 6 to 10-day cycle i.e., irrigate field and let it dry out for 6-10 days. This cycle can be modified based on soils and plant conditions; when the cracks are observed on the soils it is time to irrigate.

VIDEO (IN HINDI)

SCAN TO WATCH VIDEO

Video Link: goo.gl/M4LK82

STEP 6 Weeding

- In SRI the minimum use of water increases weed infestation; hence timely weeding is needed. Field wetting and drying requires more weeding, especially at initial growth stages.
- Start weeding 10-12 days after transplanting; repeat weeding 2 times every 10 days.

VIDEO (IN HINDI)

SCAN TO WATCH VIDEO

Video Link: goo.gl/rxGudx

STEP 7 Fertilizer application

VIDEO (IN HINDI)

SCAN TO WATCH VIDEO

Video Link: goo.gl/4UXUhL

SESSION OUTPUT

- Participants will have better understanding of cropping patterns in the region and impact of climatic variability (under different climate scenario) on crops
- Know the drought resilient crops and their sowing season
- Participants will have developed better understanding of climate resilient cropping patterns.
- Participants will be able to select the crop varieties tolerant to drought areas and adaptation technique on crop production

HANDOUTS MATERIAL FOR REFERENCE

System of Rice Intensification (SRI) in irrigated areas:

Step 1: Selection and preparation of quality viable seeds | Video (in Hindi)

https://www.youtube.com/watch?v=w5PRqOmpoC8

Step 2: Nursery plot preparation and management | Video (in Hindi)

https://www.youtube.com/watch?v=3ol0KlTcdcQ

Step 3: Land preparation | Video (in Hindi)

https://www.youtube.com/watch?v=14dcg136Gfg

https://www.youtube.com/watch?v=meIAjQ1Sgq0

Step 4: Transplanting | Video (in Hindi)

https://www.youtube.com/watch?v=Q_R_f2jwLFk

https://www.youtube.com/watch?v=57yJX6R7CeI

Step 5: Wetting and drying of the field | Video (in Hindi)

https://www.youtube.com/watch?v=EDb66uvmX_M

Step 6: Weeding | Video (in Hindi)

https://www.youtube.com/watch?v=4tLCm7l71lE

Step 7: Fertilizer application | Video (in Hindi)

https://www.youtube.com/watch?v=mUzkrn4Dx6Q

Who to contact for agro-advisories:

Nearest Agromet Field Unit:

Hill Agriculture Research & Extension Centre, Dhaulakuan, District Sirmaur (HP)

Nearest KVK:

Krishi Vigyan Kendra, Dhaulakuan, District Sirmaur (HP)

SESSION- 4 Drought preventive measures & contingency plan

OBJECTIVE

- To understand the drought preventive measures and contingency plan
- To have clear idea of contingency plan for high hill temperate wet zone, Contingency plan for mid-hills sub-humid zone and contingency plan for low hills subtropical zone
- To understand drought preventive measures of these zones

FACILITATION

STEP 1 Introduce handouts through an organized PowerPoint presentation. This would include the objective of the session and the process the facilitator will take to deliver the session. Emphasize the importance of all participants having common understanding of weather patterns and its impact.

STEP 2 Session will start with explaining what The District Agricultural Contingency are (DACP) and how useful it is for the preparedness and real time implementation towards sustainable agriculture production system in extreme climatic events.

STEP 3 Facilitator will describe further about different types of contingency plan for high hill temperate wet zone, Contingency plan for mid-hills sub-humid zone and contingency plan for low hills subtropical zone by giving examples.

STEP 4 Facilitator will also explain about the drought preventive measures in these zones.

STEP 5 To have more detailed district wise information the reference links are given. Facilitator will show how to access contingency plans for different districts.

MATERIAL REQUIRED

PowerPoint presentation, relevant handouts, chart paper, markers, tape, projector to play videos.

TIME

15 Minutes

LEARNING FACTS

S 4

The District Agricultural Contingency Plans (DACP) are technical documents aimed to be ready reckoner for line departments and farming community on prevailing farming systems and technological interventions to manage various weather aberrations such as droughts, floods, cyclones, hailstorms, heat and cold waves addressing different sectors of agriculture including horticulture, livestock, poultry, fisheries. The contingency plans are useful for preparedness and real time implementation towards sustainability agriculture production system in the events of weather aberrations and extreme climatic events.

Contingency plan for high hill temperate wet zone

Districts falling under Zone* (*>50% area falling in the zone): Shimla, Kullu, Chamba, Kinnaur, Lahul & Spiti

- **Major crops:** Maize, Paddy, Wheat, Barley, Pulses (Rajmash/Moong/Mash), Oil seeds (Mustard/ rapeseed)
- **Horticulture crops:** Apple, pear, walnut & dry fruits, citrus
- **Vegetables:** Potato, Cauliflower, French bean, Capsicum, green pea, cabbage, tomato, medicinal and aromatic crops

Major contingency in the zone: Hail storm, (regular), drought, cold wave, Pests and disease outbreak (Borers, Fungal, Bacterial and Viral diseases) occasional but increasing.

DROUGHT PREVENTIVE MEASURES

- Use of stress tolerant verities
- Use of drought resilient crops and cropping system
- Use of hail nets
- Adoption of mulching practice
- In-situ and ex-situ rain water harvesting, for efficient water management practices

Refer Module 2 on Efficient Water Management


Drip Irrigation


Drip Irrigation


Rain Water Harvesting


Mulching Practices

Contingency plan for Mid-hills Sub-humid Zone

Districts falling under Zone* (*>50% area falling in the zone): Mandi, Kangra, Solan, parts of Chamba

- **Major Field Crops:** Maize, Paddy, Wheat, Pulses, Black gram, Soybean, Wheat, Barley, Oil Seeds (Mustard/rapeseed), Linseed
- **Horticulture crops:** Apple, Stone fruits, Citrus, Mango, Litchi, Guava, Papaya
- **Vegetables:** Potato, Ginger, Turmeric, Garlic, Chilli, Green pea, Tomato, Cucurbits

Major contingency in the zone:

Regular: Drought, Hail storm; frost (December-February), Pests and disease outbreak (Fruit fly of tomato and cucurbits, Yellow rust of wheat, Bacterial wilt of tomato/capsicum, Powdery mildew of peas)

Occasional and increasing: Heat wave

DROUGHT PREVENTIVE MEASURES

- Use of stress tolerant varieties
- Use of drought resilient crops and cropping system
- Use of hail nets
- Adoption of mulching practice
- In-situ and ex-situ rain water harvesting, for efficient water management practices
- Integrated pest management (IPM)

Contingency plan for Low Hills Subtropical Zone

Districts falling under Zone* (*>50% area falling in the zone): Bilaspur, Hamirpur, Solan, Kangra, Sirmaur, Solan

- **Major Field Crops:** Maize, Paddy, Wheat, Barley, Mash, Gram, Lentil, Oil seeds (Mustard/Sesame)
- **Horticulture crops:** Mango, Citrus, Apple, Pear, Peach, Orange
- **Vegetables:** Potato, Ginger, Garlic, Green pea, Tomato

Major contingency in the zone:

Regular: Heat wave, frost; pest attack (Fruit fly of guava, mango, peach, tomato and cucurbits, stem borer and leaf folder of rice, powdery mildew and leaf miner of peas, rhizome rot of ginger, buckeye rot of tomato, brown and false smut of rice, loose smut of wheat, Erwinia stalk rot, maydis leaf blight in maize, yellow rust and Karnal bunt in wheat, ginger fly)

Occasional and increasing: Drought, pest attacks like aphid, maize stem borer, brown plant hopper, white butterfly of cole crops, bacterial wilt and phytophthora blight of Solanaceous crops, Yellow rust, leaf blight in barley, blister beetle in mash (pulses)

DROUGHT PREVENTIVE MEASURES

- Use of stress tolerant varieties
- Resilient crops and cropping system
- Use of hail nets
- Adoption of mulching practice
- In-situ and ex-situ rain water harvesting, for efficient water management practices
- Integrated Pest Management (IPM)

Detailed Contingency Plans for all the districts of Himachal Pradesh that lists contingency measures for low, mid and up land agriculture can be accessed at below link.

DISCUSSION POINT

What are the understanding of participants about contingency plans and how to get benefit from them?

RECOMMENDED WEBSITE

http://agricoop.nic.in/agriculturecontingency/himachal-pradesh

HANDOUTS

Participants will be given district level contingency plan handouts

Refer to Module No. 2 for efficient water management practices
Refer to Module No. 4 for Integrated Pest Management

SESSION- 5 Pest control measures in different crops as drought contingent plan

OBJECTIVE

- To understand the Pest control measures in different crops as drought contingent plan

FACILITATION

STEP 1 Introduce handouts through an organized PowerPoint presentation. This would Include the objective of the session and the process the facilitator will take to deliver the session. Emphasize the importance of all participants having common understanding of weather patterns and its impact.

STEP 2 Session will start with explaining what the Pest control measures are in different crops as drought contingent plan and for more details facilitator will swiftly move to module 4 which has detailed explanation.

STEP 3 To review the understanding of participants, an exercise sheet will be given to them to fill in 5 minutes. The exercise will translate the success of the session and involvement of the participants in the training session.

MATERIAL REQUIRED

PowerPoint presentation, relevant handouts, chart paper, markers, tape, projector to play videos.

TIME

10 Minutes

LEARNING FACTS

S 5

The following insect/pests and diseases appear more frequently under drought situation for which it requires constant vigilance to take up timely control measures.

INSECTS

(I) Rice

- Stem borer attack starting from nursery to main field will increase as the temperature (280-380C) and humidity remain high
- Mealy bug attack on direct sown and upland rainfed rice will increase
- Foliage damage by grasshoppers, leaf minor (Hydrolliagriseola) and grub of hispa may increase
- Surti and other hairy caterpillars will increase and damage the crop in inland districts.

(II) Sugarcane

- Termite and mealy bug attack will increase. Among the borers, early shoot borer attack will continue to shoot.

(III) Groundnut

- Soil dwelling insects such as white grubs, earwigs, wireworms and termites will damage the plants and pods.

(III) Vegetables

- Epilachna beetles (in gourds and brinjal), shoot and fruit borers and fruit flies will increase damage. Damage due to ants will also be increased.

DISEASES

(I) Rice

- Brown spot and blast diseases increase under the dry condition.

Refer to Module No. 4 on Integrated Pest Management

EXERCISE

1 What are the extreme weather events of Himachal Pradesh?

- **A** Flash Flood
- **B** Glacial Lake Outburst Flood
- **C** Drought
- **D** All of them

2 How do you experience change in climate in your region?

- **A** Delayed monsoon
- **B** Rise in temperature
- **C** More intense rainy days
- **D** All of them

3 What are the advantages of inter-cropping?

- **A** Efficient use of nutrient resource
- **B** Reduces pest–insect incidences
- **C** Insurance against failure of one crop due to weather events
- **D** All of them

4 How many zones are in HP based on Horticulture resources?

- **A** 2
- **B** 4
- **C** 5
- **D** 3

5 What are the advantages of System of Rice Intensification (SRI) in HP?

- **A** High yield
- **B** Less water requirement
- **C** Cold tolerance
- **D** All of them

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