Chapter-3

Design and Development of Climate Resilient Agriculture Farms

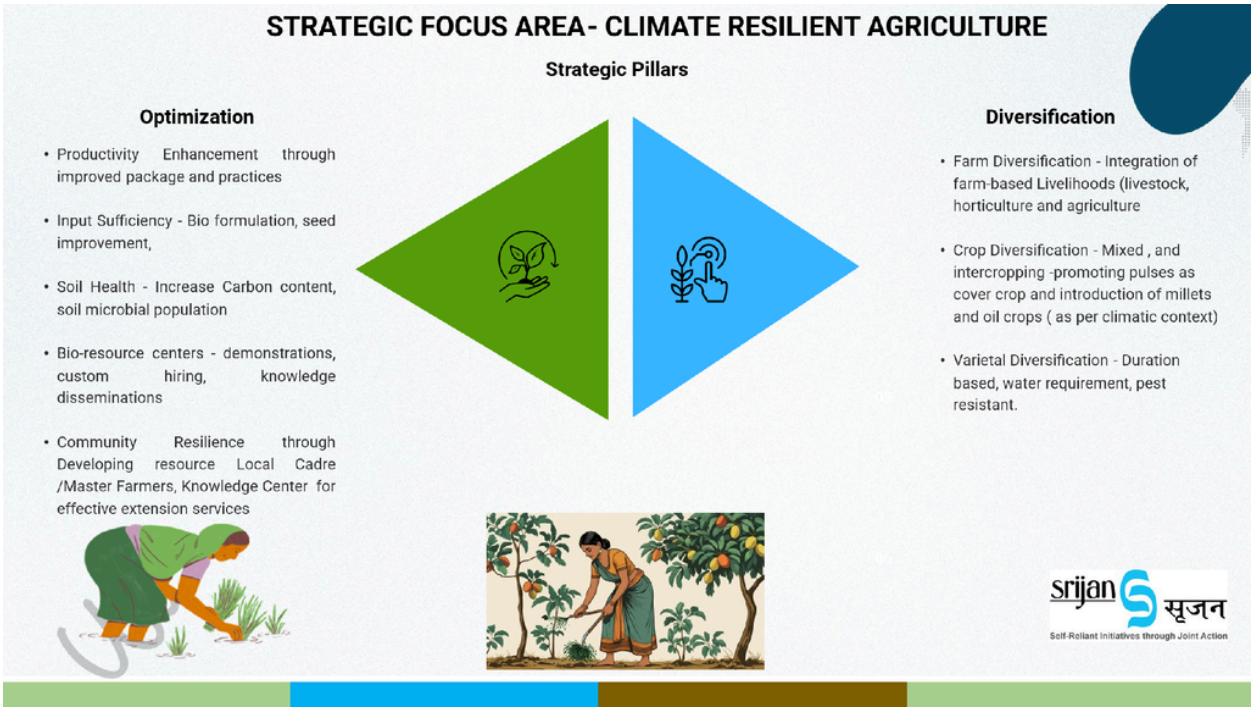
Non-Negotiables for Climate-Resilient Farming: SRIJAN's climate-resilient farming approach will follow the following non-negotiable principles to ensure that interventions are women-led, farmer-centric, locally appropriate, and ecologically sustainable:

- **Women-led and women-focused:** Programs will be developed exclusively for women farmers, with a strong focus on building their leadership, farm management, and decision-making capacities. Women will be supported to take complex decisions related to farm diversification, transition from conventional farming, resource management, market competition, and improving farm and labour efficiency.
- **Priority to resource-poor farmers:** The primary participants will be small and marginal women farmers, particularly those with limited land, assets, and access to productive resources.
- **Participatory assessment:** The program will begin with mapping farmers' existing knowledge, skills, resources, challenges, and opportunities, along with stakeholder and institutional analysis.
- **Active participation in planning and implementation:** Women farmers will actively participate in planning, on-field training, demonstrations, experimentation, monitoring, and evaluation rather than being passive recipients of technology.
- **Strong capacity building and group development:** A rigorous capacity-building module will strengthen:
  - -Trust and group cohesion
  - -Group dynamics and collaboration
  - -Critical analysis and problem-solving
  - -Planning and decision-making
  - -Feedback and evaluation
  - -Leadership and collective action
- **Locally appropriate learning curriculum:** Training content, demonstrations, and learning methods will be adapted to the local agro-ecological conditions, farming systems, available resources, farmer knowledge, and climate risks.
- **Group-based approach:** The program will use a group-based learning and action approach, supported by regular meetings, peer learning, field demonstrations, and collective review of progress.

Seed principle: Genetic Modified and hybrid seeds will not be promoted. The program will prioritize locally adapted, open-pollinated, indigenous, and suitable improved varieties where appropriate and feasible.

Chemical-free crop management: Chemical pesticides, weedicides, and synthetic fertilizers will not be promoted. The program will emphasize ecological approaches such as soil health management, biodiversity, biological and botanical solutions, integrated ecological pest management, and locally available farm resources.

Strategic Focus Area -CRA:



Optimisation of Resources:

1. **Farmer's Group:** Climate-resilient agriculture requires not only individual farmers to acquire ecological knowledge and practices but also collective capacity to generate, adapt, share, and apply locally relevant knowledge. SRIJAN will therefore facilitate farmer groups to jointly understand farm-level problems, identify their root causes, and develop sustainable and climate-resilient solutions.

   A group of approximately 25 farmers will serve as the critical mass for peer learning, mutual support, experimentation, and collective action. SRIJAN extension workers will recognize farmers as knowledge holders and co-creators of solutions, while development professionals and scientists will provide technical support. The process will combine scientific knowledge with farmers' local experience and traditional wisdom.

   The overall approach will be farmer-driven and farmer-accountable, with bottom-up planning based on local field research and observation. Farmers will regularly analyse pests and diseases, soil conditions, plant health, weather and climatic factors, and other factors affecting crop performance. The knowledge and successful practices generated through these processes will be documented, demonstrated, and shared with a wider farming community.

2. **Master Farmer/Champion Farmer/Lead Farmer:** A Master Farmer will be selected from among the farmers of 3–5 adjoining farmer groups. The Master Farmer will undergo a season-long, structured training program covering both relevant technical knowledge and facilitation methodology. He/She should coordinate with PKK (BRC) in charge and farmer group members.

A suitable Master Farmer should:

- Have advanced knowledge, skills, and practical experience in agriculture and livestock.
- Be willing to share knowledge and field experience with other farmers.
- Have strong facilitation, mentoring, communication, and leadership skills.
- Demonstrate a positive and learning-oriented mindset.
- Be approachable and trusted by farmers.
- Be capable of facilitating 3–5 farmer groups, depending on the farmer's capacity, skills, and accessibility.
- Be committed to helping needy farmers access appropriate technologies, inputs, services, and credit.
- Demonstrate the ability to support farmers in problem identification, analysis, experimentation, and decision-making.

Master Farmer Certification: Master Farmers will undergo pre- and post-training assessments to measure learning and skill development. A certificate will be awarded upon satisfactory completion of the training, based on attendance, participation, and learning performance.

3. **Farmer's Field Day:** Farmer knowledge develops continuously through practical experience, experimentation, and solving day-to-day problems in interaction with the farm environment. Therefore, SRIJAN organize farmers' field day based on "learning by doing" and "learning from the field" approach.

With support from the extension worker (SRIJAN/Line Department) and Master Farmer, farmers will learn to:

- Observe crops and field conditions systematically.
- Identify and analyse problems affecting crop health.
- Understand inter-relation among soil, plants, pests, diseases, weather, and farm management.
- Make informed and timely crop-management decisions.
- Conduct and learn from field trials and demonstrations.
- Develop their own learning materials through field observations, drawings, records, photographs, and simple documentation.
- Share experiences and findings with other farmers.

The farmer learning process will follow crop phenology and critical crop-growth stages rather than relying only on classroom-based training. Farmer groups will meet at agreed intervals, preferably every 1–2 weeks interval as per critical crop-growth stages. Each meeting should have a clearly defined start and end time to maintain focus, discipline, and participation.

The group will walk through the selected field and randomly select 5-10 representative plants/hills for detailed observation. Farmers will carefully observe and record the following:

A. Plant Growth and Health

- Plant height and number of leaves/tillers.
- Current crop-growth stage.
- Overall plant vigour and health.
- Symptoms of pests, diseases, nutrient deficiencies, or other abnormalities

B. Pest and Crop Damage

- Identify and count pests at different parts of the plant.
- Observe the type and extent of pest damage or injury.
- Note where the pests are found—leaves, stem, flowers, pods, fruits, etc.

C. Natural Enemies

- Identify and count predators and parasitoids/parasites.
- Observe beneficial insects and other natural enemies.
- Record their location on the plant and their interaction with pests.

D. Weeds

- Identify major weed species.
- Assess the intensity and distribution of weeds in the field.

E. Soil, Water and Nutrient Status

- Observe soil moisture and general soil condition.
- Assess water availability and water distribution in the field.
- Record visible symptoms of nutrient deficiency or excess.

F. Weather and Climate

- Record current weather conditions such as temperature, rainfall, wind, cloud cover, and humidity where possible.
- Review available weather forecasts and discuss their implications for crop management.

The Master Farmer will facilitate the discussion and ensure the drawing or symbols of field demonstrations so that literacy does not become a barrier to participation. The entire group will agree on the required field-management actions. The group and Master Farmer will ensure that agreed activities are implemented.

4. **Input self-sufficiency** will be a core principle in designing climate-resilient farming interventions. The objective is to progressively reduce farmers' dependence on externally purchased agricultural inputs by strengthening their capacity to produce, conserve, recycle, and manage farm resources locally.

   The intervention should prioritize locally available and renewable resources and build farmers' knowledge and skills to prepare and use appropriate inputs according to crop and field requirements.

- Promote maximum use of locally available farm and natural resources.
- Develop farmers' capacity to prepare and use bio-inputs such as Beejamrit, Jeevamrit, Ghanjeevamrit, botanical preparations, and other locally appropriate formulations.
- Strengthen access to and management of quality seed through farmer seed systems, seed banks, and farm-saved seed.
- Promote on-farm nutrient recycling through compost, crop residues, animal manure, green manure, and other biomass resources.
- Encourage local production and conservation of planting material, including vegetables, fruit, agroforestry, and other suitable crops.
- Strengthen community-level facilities such as BRC/PKK, seed banks, nurseries, and tool banks to support input and service availability.
- Develop systems for collection, quality management, storage, and timely availability of locally produced inputs.
- Ensure that input self-sufficiency contributes to lower production costs, greater farm resilience, and reduced dependence on external markets.

Diversification of Farm:

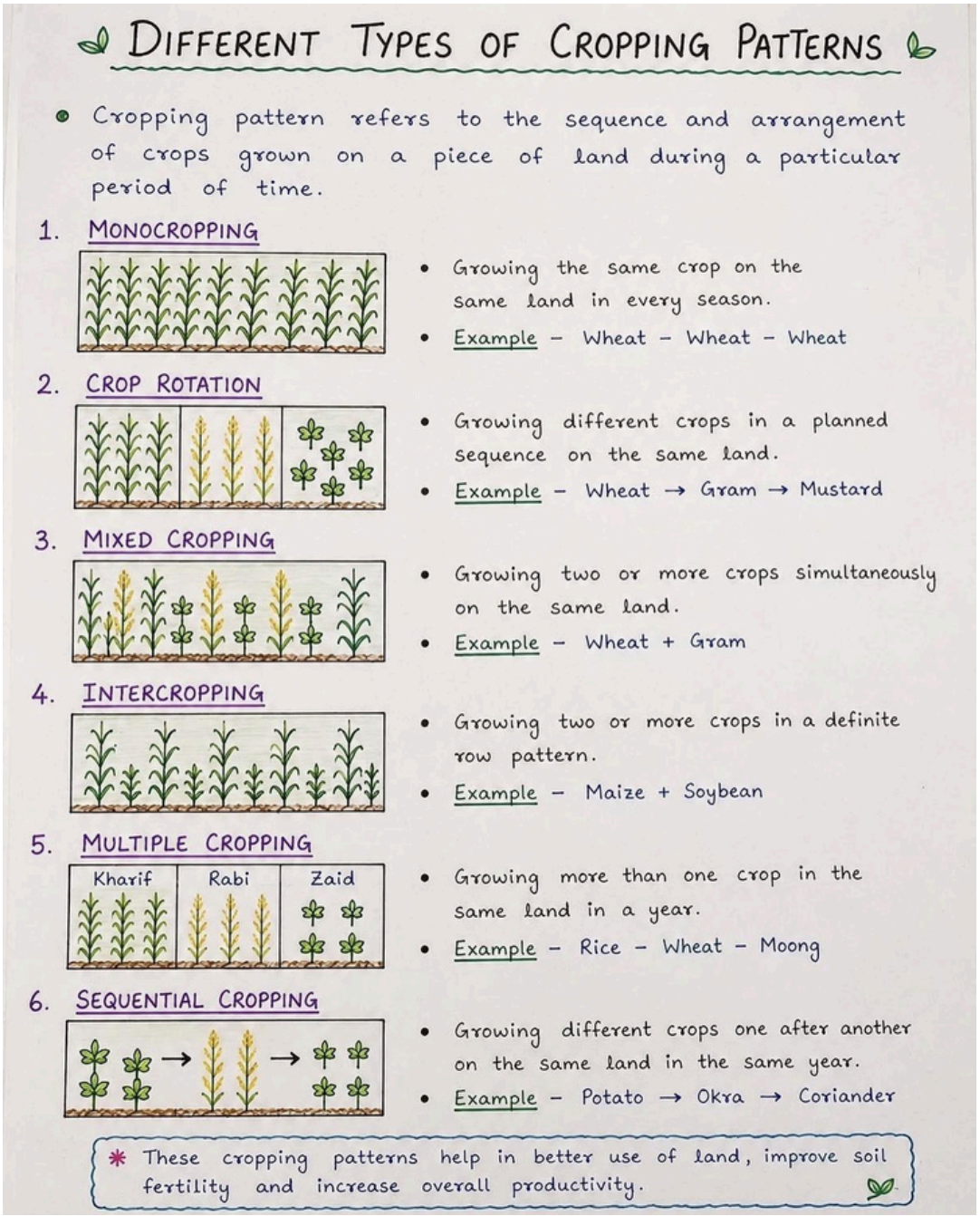
1. **Crop Planning:** Crop planning is a critical component of climate-resilient farming. Traditionally, farmers selected crops based on household food requirements, market demand, availability of local and natural resources, and the need to minimize crop-failure risks. However, increasing market orientation has encouraged monocropping and reduced crop diversity in many farming systems.

   Monocropping can reduce agro-biodiversity, disturb ecological balance, and increase farm vulnerability to pests, diseases, market fluctuations, and climate-related risks. Therefore, SRIJAN will promote diversified and locally appropriate cropping systems that balance food and nutritional security, income, resource availability, ecological sustainability, and climate resilience.

   Crop planning should consider:
   - Household requirements for staple and nutritious food crops.
   - Local agro-climatic conditions and climate risks.
   - Soil type, fertility, and moisture conditions.
   - Availability of irrigation and other farm resources.
   - Crop water requirements.
   - Market opportunities and price risks.
   - Availability of locally adapted and suitable seed.
   - Labour availability and farm-level capacity.
   - Risk of crop failure and opportunities for spreading risk across crops and seasons.

Water Budgeting based Crop Planning: Water budgeting should be an integral part of crop planning, particularly for Rabi crops. The choice of crop and variety should be based on the quantity, reliability, and timing of available water, rather than planning crops first and arranging water later.

SRIJAN will promote water-efficient cropping systems and drought-tolerant or climate-resilient varieties suited to local conditions. The objective is to improve water productivity—more food and income per unit of water—while maintaining household food security and reducing climate-related crop risks.



Water budgeting and crop planning should assess:

- Water availability – rainfall, groundwater, surface water and recharge potential.
- Water requirement – crop- and variety-specific water needs.
- Irrigation method – efficiency and suitability of the available irrigation system.
- Cropping pattern – selection and combination of crops according to available water.
- Critical irrigation stages – prioritization of water during stages when irrigation has the greatest impact on yield.
- Water-saving practices – soil-moisture conservation, appropriate irrigation scheduling, mulching and other locally suitable practices.
- The SRIJAN team will coordinate with agricultural research stations, Krishi Vigyan Kendras (KVKs), and State Seed Corporations to identify suitable drought-tolerant crop varieties based on local agro-climatic conditions and water availability.
- Risk management – avoiding excessive dependence on water-intensive crops where water availability is uncertain.

2. **Mixed Cropping and Intercropping:** Mixed cropping and intercropping of cash crops with staple food crops can help small and marginal farmers minimize crop failure risks, diversify farm income, and improve farm resilience.

   Mixed cropping involves growing multiple crops together without a fixed row pattern or proportion, whereas intercropping involves growing two or more crops in a definite row pattern or ratio. Intercropping facilitates intercultural operations and efficient resource utilization, while mixed cropping can support soil health and soil conservation. For example, chickpea (Bengal gram) mixed with mustard can contribute to soil fertility and diversify production.

   - Document Local Practices: Identify traditional crop combinations, local wisdom, and package of practices adopted by farmers.
   - Develop Crop Combinations: Design mixed cropping and intercropping systems based on farmers' preferences, resource availability, and crop compatibility.
   - Validate Crop Combinations: Discuss and validate proposed crop combinations with farmers during village meetings.
   - Promote Crop Diversification: Integrate cash crops with staple food crops, pulses, and cover crops to reduce crop failure risks, improve soil health, and diversify farm returns.

3. **Crop Rotation:** Crop rotation is an important agroecological practice that involves growing different crops on the same field in a planned sequence across seasons or years. It helps maintain soil fertility, break pest and disease cycles, improve nutrient-use efficiency, manage weeds, and reduce climate-related production risks.

   Key Steps for Crop Rotation

   - **Assess Existing Cropping Systems:** Document existing crops, cropping sequences, soil types, irrigation availability, rainfall patterns, and farmers' food and income requirements.

- **Identify Suitable Crops:** Select locally adapted crops, prioritizing crop diversity, including cereals, pulses, oilseeds, and legumes, based on agro-climatic conditions and household needs.
- **Design Crop Rotation Sequences**: Develop season-wise and year-wise crop sequences, incorporating leguminous crops and crops with different rooting depths and nutrient requirements to improve soil health and resource-use efficiency.
- **Demonstrate and Validate Crop Rotations:** Establish demonstration plots with selected farmers to assess crop performance, productivity, soil health, input costs, and economic returns under different crop rotation sequences.
- **Monitor and Refine Rotation Plans:** Review crop yields, profitability, soil health, water use, and farmer feedback annually. Refine crop rotation plans based on field observations and changing climatic and market conditions.

4. **Promotion of Cover Crop:** Cover crops are crops grown primarily to protect and improve soil health rather than for direct harvesting or commercial production. They help maintain soil cover, reduce erosion, improve soil organic matter, conserve moisture, suppress weeds, and support beneficial soil organisms. In the context of SRIJAN's Climate-Resilient Agriculture approach, cover crops can play an important role in restoring soil health, improving water-use efficiency, enhancing biodiversity, and reducing climate-related risks.

   - Promote locally adapted species based on agroclimatic conditions, crop rotation, and farmer needs. Examples include cowpea, Dhaincha, Sunhemp, various grams, and other suitable legumes or grasses.
   - Cover crops may be grown during fallow periods, between main crops, or as intercrops, depending on local conditions.

5. **Seed Depth and Line Sowing**: Appropriate seed depth is essential for uniform germination and crop establishment. In general, small seeds should be sown at 2–3 cm, medium-sized seeds at 3–5 cm, and large seeds at 5–6 cm, subject to crop-specific recommendations and soil conditions. Seed depth should be checked during line sowing using a seed drill. Broadcasting should be avoided where uniform sowing depth and crop establishment are critical.

   Line sowing is particularly important during dry spells in the Kharif season, as seeds placed at an appropriate depth can access more consistent soil moisture than broadcasted seeds. It also facilitates intercultural operations, including hoeing and weeding, which help control weeds and break soil capillarity, thereby reducing moisture loss through evaporation. SRIJAN should promote line sowing, particularly for Kharif crops, as a climate-resilient agricultural practice to improve crop establishment, moisture conservation, and ease of farm operations.

   - Ensure Appropriate Seed Depth:
   - Follow crop-specific seed-depth recommendations and check seed placement during line sowing using a seed drill.
   - Promote Line Sowing: Encourage line sowing over broadcasting to ensure uniform seed placement, better crop establishment, and ease of intercultural operations.

6. **Border Plantation:** We experience that border plantations contribute a lot to maintaining in-situ biodiversity, increasing soil carbon, protecting the crop from hot and cold waves, especially in the case of commercial crops, and pool of carbon sequestration.

   - Identify Suitable Species: Select locally adapted, straight-growing fodder, timber, or fruit plants based on farmers' preferences and local conditions.
   - Plan Plantation Layout: Design border plantations with wider spacing (at least 1.5–2 times the recommended compact plantation spacing) to facilitate cultural operations and minimize shading of the main crop.
   - Prefer an east–west alignment, wherever feasible, to support sunlight penetration, facilitate aeration during crop growth, and provide protection from hot summer winds.
   - Ensure Adequate Plant Population: Promote at least 50–100 plants per hectare, depending on farm size, layout, and farmers' preferences.

7. **Integration of Livestock and Horticulture Crop:** Integrate crop production, livestock rearing, and horticulture to diversify income, recycle farm nutrients, optimize resource use, and enhance climate resilience.

   - Assess Farm Resources: Identify available land, water, livestock, labour, and other farm resources.
   - Select Suitable Components: Integrate field crops, horticulture, and livestock based on farmers' preferences and local agro-climatic conditions.
   - Develop Farm Plans: Design farm-specific integrated models considering resource availability, household needs, and market opportunities.
   - Promote Resource Recycling: Utilize farm waste, crop residues, and animal dung for composting, bio-input preparation, and nutrient recycling.
   - Enhance Income and Resilience: Promote diversified production systems to improve farm income, resource-use efficiency, and climate resilience.

8. **Crop Residue Management:** India generates approximately 500–550 million tons of crop residues annually, around 70% of which comes from cereals. Although residues are used for animal feed, mulching, composting, thatching and fuel, a significant quantity is burnt in fields, particularly after Kharif harvesting, to facilitate timely sowing of the next crop. Residue burning causes air pollution and nutrient loss, while labour shortages and increasing cropping intensity are likely to intensify the challenge. Efficient crop residue management is therefore essential for soil health, climate resilience and sustainable agriculture.

   The following areas will be prioritized:

   - **Crop Residue Assessment:** Develop region-specific crop residue inventories to estimate production, quality, existing utilization and on-farm burning, using satellite imagery to assess residue burning and explore carbon credit opportunities.

- **Residue Utilization and Feasibility:** Assess the suitability of crop residues for on-farm and off-farm uses, including mulching, animal feed, compost, biogas, biochar, biofuel and energy generation. Evaluate their benefit–cost ratio, technical feasibility and socio-economic impact.

- **In-situ Residue Decomposition: P**romote efficient microbial strains and suitable technologies to accelerate residue decomposition, enabling in-situ incorporation and improving soil health.

- **Sustainable Residue Retention:** Determine crop- and region-specific residue retention and incorporation levels based on cropping systems, soil characteristics and climatic conditions, while preventing operational challenges during subsequent sowing and maintaining soil chemical and biological balance.

