Chapter 3

Project Components

Under RACP the project components selected are primarily with the objective of increasing production with input resource management specially in relation to water conservation, harvesting and its use, bringing higher economic benefits to the farming community through holistic and integrated approach for marketing and value chain development. Since agriculture in Rajasthan heavily depends on monsoon the strategic option available is harvesting every drop of water and maximizing production per unit of water keeping sustainability the agriculture system in focus.

The project components address capacity, access and participation-related issues by (i) incentivizing group formation among smallholder farmers (e.g. water user groups, ground water management communities, watershed groups, commodity groups) through specialized service providers; (ii) promoting farmer access to farm inputs, advisory services, product markets as well as agriculture insurance; and (iii) promoting gender-equitable practices in the sector.

The project will be taken up in 20 clusters two each in different agro climatic zones of the state. These 20 regional clusters are covering different agro-climatic conditions of the state. Selection of these geographical clusters has also taken into account, inter alia, drought-proneness, soil types, cropping pattern, sources of irrigation, marketing infrastructure, prospects for value chain and livestock population. Each cluster represents rainfed agriculture, ground water irrigated or surface water irrigated agriculture. In each of the cluster one major commodity grown in Kharif and Rabi is identified for marketing and value chain approach and the focus of the activities is on having an integrated and holistic end to end approach/value chain approach. Since, livestock is an integral part of livelihood security in the state the focus would also be on enhancing its productivity. Large ruminant livestock are excluded from the project design as it is likely to be covered under another World Bank supported project. Therefore focus in RACP would be on small ruminants specially goat.

The four major components include:-

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Component 1: Climate Resilient Agriculture

Component 1A: Improving Water use Efficiency

The guiding principles on water management practices agreed in principle for the planning and implementation of water resources related interventions associated with three different water scenario i.e. (i) watershed in rainfed areas, (ii) groundwater irrigation and (iii) surface (canal) irrigation in Cluster Agricultural Competitiveness Plans (CACPs) under the RACP are:

1. Watershed

1.1 Introduction

Survey of the agriculture situation in rain-fed areas have shown that these areas are characterised by decrease in the water table, land degradation due to soil erosion, increase in population, poor livestock productivity, fodder shortage and un-organised marketing opportunities. Therefore, in RACP clusters where watershed opportunities exist, have been selected for integrated development of value chain with focus on integrated farming system for increasing productivity, livelihood, enhanced and regular income. Research conducted for rainfed areas has shown that the efficient water management through soil and water conservation measures is the key for sustainable development. The integrated watershed approach i.e. conserving natural resources of water, soil and vegetation has been accepted as major theme for development of rainfed areas in RACP.

Cluster Approach: Under new approach, watershed areas; which may comprise of macro / micro watershed delineated boundaries, index catchments, catchments of ground water clusters and catchment of canal surface water clusters will be selected envisages a broader vision of area based approach. The average size may range from 10,000-15000 hectares. Special efforts will be made to utilize the information technology and remote sensing inputs in planning, monitoring and evaluation of the programme. Capacity Building and training of all functionaries and stakeholders involved in the watershed programme implementation would be carried out with definite action plan and requisite professionalism and competence. In the existing and proposed cluster areas to be selected, Four Waters Concept will be retro-fitted as per requirement and feasibility of the area.

Facilitating Agencies: For social mobilisation, community organization, capacities building of communities in planning and implementation, an NGO will be hired by the project, who will work at DPMU, level.

Centrality of Community Participation: Involvement of primary stakeholders is at the centre of planning, budgeting, implementation, and management of watershed projects. Community organizations will be closely associated with and accountable to Gram Sabhas for project activities.

Capacity Building and Technology Inputs: Considerable stress would be given on capacity building as a crucial component for achieving the desired results. This would be a continuous process enabling functionaries to enhance their knowledge and skills and develop the correct orientation and perspectives thereby becoming more effective in performing their roles and responsibilities. With current trends and advances in information technology and remote sensing, it is possible to acquire detailed information about the various field level characteristics of any area or region. Thus, the endeavour would be to build in strong technology inputs into the new vision of watershed programmes.

Monitoring, Evaluation and Learning: A participatory, outcome and impact-oriented and user-focused Monitoring. Evaluation and Learning system would be put in place to obtain feedback and undertake improvements in planning, project design and implementation.

Organizational Support: Appropriate technical and professional support structures at state, district level & developing effective functional partnerships among project authorities, implementing agencies, departments & support organizations would be at the core.
**Planning and Implementation Agency:** Under re-structured mode of RACP, the planning and implementation of Watershed (Catchment Area) development Sub Plan of the CACP will be carried out by the concerning line department of Watershed Development & Soil Conservation, GoR. A separate dedicated Project Implementation Unit (PIA) will be set up, who will be responsible for planning and implementation of sub plan of CACP through district / block level functionaries of the Department. DPMU of RACP will supervise the works. Department will provide dedicated technical man power to the PIU and DPMUs. Other requisite man power will be hired by the project from open market through Man Power agency.

**1.2 Technology Inputs**

The endeavour would be to build in strong technology inputs for watershed programmes. Core GIS facilities, with spatial & non-spatial data, would be established and augmented with satellite imagery data received from NRSA, ISRO and Survey of India. All the GIS layers for various themes would be overlaid having a geo-referenced base layer up to the level of village boundaries. Application software for web-enabled integrated watershed development, spatial & non-spatial data standards and meta-data would also be in place which would allow defining watershed project boundaries. Remote sensing data would be utilized for finalizing contour maps for assessment of run-off and for identifying structures best suited.

**1.3 Project Activities:**

1. **Institutional Activities:**

   i. **Finalization of project boundaries / pilot areas:** In the identified cluster area, boundaries should be delineated and finalized so that intervention and beneficiaries covered could be targeted in a better planned way.

   ii. Identification of **potential beneficiaries and other stake holders:** During the planning process, before CACP preparation, all the stake holder including farmers, land less beneficiaries, PRIs etc. will be finalized.

   iii. Formation of **Multi Task Group (MTGs)** of individual land based activities by involving 15-20 no. of farmers (Farmers having lands/fields adjoining or contiguous)

      (i) MTGs will be formed by the NGO selected for community mobilisation.

      (ii) These MTGs will be responsible for all types of interventions under RACP like watershed development, agriculture, horticulture etc., most importantly marketing & value chain activities etc.

      (iii) In case of livestock component, separate MTGs will be formed for small ruminants.

      (iv) Each member of the MTG will carry out work in their own fields by themselves or through labourers and suitable machines.

      (v) The beneficiary of the MTGs should be willing to pay **beneficiaries contribution** in the form of cash/labour/material.

   iv. **Formation of Users Groups (UGs)** who have resource dependency, sharing arrangement and responsibility of management of common property resources / assets by involving 10-15 users.

      (i) NGO will form Users Groups (UGs) by motivating & involving beneficiaries with the help of local PRIs, who are directly or indirectly going to accrue benefits from each of interventions carried out on community/common/panchayat land of cluster area.

      (ii) Activity wise UGs shall be formed. UGs may be formed for Water Harvesting Structures, Anicut & Pasture Land Development activities.

      (iii) UGs will be responsible for operation and maintenance of all assets created under the project with the support of MTA/PRIs.
(iv) NGO in consultation with Gram Panchayat shall facilitate resource-use agreements, out of assets created among UG members based on principles of equity & sustainability.

(v) NGO to ensure that these agreements between UGs & Gram Panchayat are worked out through MTA before commencement of work. It must be regarded as a pre-condition.

v. **Formation of Multi Task Association (MTAs) at Gram Panchayat level.**

NGO, in consultation with concerning DPMU will form the Multi Task Associations (MTAs) at the Gram Panchayat level by federating Multi Task Groups (MTGs) and Users Groups (UGs) formed at the village level. The MTAs will be a registered body under Society Act & will have its own bye-laws. General Body of MTA shall comprise of all Leaders & Co-Leaders of MTGs & UGs as members.

MTAs shall be responsible for:

(i) implementation of activities on common/Panchayat land through concerned UGs.

(ii) monitoring the activities on arable lands through MTGs.

(iii) preparing Byelaws & registration under society act, conduction regular meetings of General Body & Executive Committee to review the progress of activities of MTGs, UGs.

(iv) ensuring engagement of labours, record keeping, ensuring payments to labours & for other works with the help of CRP.

(v) having close liaison with Gram Panchayat/Gram Sabha particularly on community issues.

(vi) allocate usufruct rights to deserving UGs with the help of Gram Panchayat for developing & maintaining the assets to be created on common/panchayat lands.

vi. **Federation of MTGs/UGs/MTAs at the cluster level to form Cluster Level Producer Organization (CLPO).** To support economic & managerial activities at large scale, federations of MTAs/MTGs/Beneficiaries would be formed at the cluster level, which will be termed as CLPO and duly registered. These would further strengthen & activate the linkages established with external resource agencies for knowledge, credit, input procurement, sale of local produce, carrying on processing activities to the point of exports etc. In these activities, bankability of the activities will be attempted. These CLPOs shall have major role in supervising & coordinating marketing & value chain activities in the cluster.

vii. **Identification of Community Resource Persons (CRPs) for MTAs/CLPOs:** Each MTA, with the support of NGO will have one Community Resource Person (CRP), who will work as office secretary of MTA. CPRs shall be responsible for the record keeping and other office work at MTA level.

viii. **Important activities by NGO:**

For activities like Community Mobilization, IEC, Group formation, training and capacity building etc., a suitable NGO would be hired by the project who will work at the project level under DPMU and concerning DPMU will supervise the works of NGO.

NGO will establish farmers / beneficiary groups around watershed management, agriculture, horticulture, livestock and value chain development. Any household farmer / landless can be a member of each of these thematic group organized around common interests, depending on their participation in different activities.

a. **PRA exercises and interaction with the beneficiaries, Gram Panchayat / PRI.**
PRA is an important exercise to facilitate Community Mobilisation & preparation of Annual Action Plan. NGO will carry out village wise PRA with the help of MTGs, MTAs, UGs, PRIs. For each village, separate maps will be prepared, showing all special features such as nallas, pastures, roads, dhani's etc. Works will be identified according to beneficiaries need.

PRA is a process of Involvement with rural people for indigenous Knowledge Building Exercise or way of learning from & with villagers to investigate, analyze & evaluate constraints & opportunities, need assessment & priorities in water, agriculture, social & economic programmes addressed to village development.

b. Environment Building, Awareness Generation, Community Mobilisation and IEC activities.

This is an important component & would help in creating necessary environment & support for undertaking project activities. Initially, Orientation training programmes with the support of ARAVALI will be organized. IEC would be undertaken by the NGO with the support of DPMU for Community mobilisation. This would be a continuous process enabling functionaries to enhance their knowledge, skills & develop the correct orientation & perspectives thereby becoming more effective in performing their roles & responsibilities. Intensive IEC campaign will be organized to inculcate the sense of belonging among the community for all project activities. Individually addressed communication through participatory work between project & the local communities is important. To facilitate such communication prepare regular pamphlets/newsletter, other minor publications in an effective manner, Wall Paintings, Display Boards, Focused Group Meetings would be planned. CRP of MTA will write information on the display Board. IEC will create social consensus; necessary to motivate local beneficiaries to join & participate in local level group formation & other collective activities.

c. Trainings & Exposure visits of all the stake holders (farmers, MTGs, UGs, MTAs, CLPOs) including PRIs.

Training is very significant activity towards achieving project development objective under RACP. The project success is heavily depending on successful implementation of trainings under the project. Objective of this activity is to build capacity of farming community, women farmer’s, as well as project staff so that Project objective on Watershed, Agriculture, Horticulture, Livestock, Market & Value Chain Sub Component may be achieved. Time bound & regular trainings programs will be required under the project. Detailed training programme for each sector/community will be prepared by NGO & DPMU. A training manual is being prepared by PMU, which will be referred to as per need.

The objective of exposure visits is to realize the farming community, PRIs, community groups, project staff etc. about the impact of the activities proposed in the project. The Exposure visits for farming community, PRIs, community groups, project staff etc. within the state and outside the state should be organized so that they could explore their knowledge as well as experiences about the technical and social innovations. Exposure visits of successful work/project including Animal Husbandry projects in State as well as National level should be organized in such a way that members of community based groups, PRIs, project staff are covered in phases. A data base should also be prepared for monitoring of impact of this program.

ix. Procurement of IT equipment i.e. computers and peripheral & scanners etc. for the PIUs/line department/ MTAs/CLPOs.

x. Working out detailed resource-use agreements (for surface/ground water & common / forest land usufructs) among UG members in a participatory manner based on principles
xi. Role of Gram Panchayat (GP):

Following important functions would be carried out with the support of Gram Panchayat:

a. The teams of specialists of DPMU will place the GP level annual action plan of activities of CACP, in the meeting of Gram Sabha for perusal. In case Gram Sabha meeting is not scheduled to be held soon, then, copy of GP level plan will be sent to the Gram Panchayat for perusal.

b. NGO/MTAs/MTGs/UGs will take the support/advice from Gram Panchayat from time to time.

c. Convergence of various other projects/schemes in the project area will be facilitated by the concerning Gram Panchayats.

d. GP will make available common lands/structures/property to MTA/project for development in the cluster area.

e. Office accommodation & other facilities to MTAs as per need/local requirements will be facilitated by the concerning Gram Panchayats.

2. Physical Activities:

A. General Activities:

i. Collection of basic required data:

Basic information/base line data of rainfall, temperature, location including geographical coordinates, topography, hydrology, hydrogeology, water sources available & its present status, soils, soil profile, fertility status, forests, demographic features, farmers profile (small, medium, large, commercial/non-commercial), ethnographic details of communities, land-use pattern, major crops (including horticulture) & their productivity, cropping pattern, seed replacement rate, fertilizer availability & consumption, present marketing status, land-use pattern, infiltration rate and field capacity, livestock etc. shall be collected. Details of stakeholders of cluster, including but not limited to, farmers & organizations representing farmers i.e. MTGs/UGs/MTA/CRP etc., suppliers of various inputs (both from private & public sectors), processors, agribusiness enterprises will be collected.

ii. Base line survey base line survey of cluster area for carrying out socio economic analysis apart from other required surveys:

Base line survey of cluster area will be carried out for socio economic analysis apart from other required surveys. Concerning DPMU will guide the NGO and his team for this task. Comprehensive beneficiary level database separately for private & community land to be prepared with linkages to cadastral database. It will facilitate spatial depiction of action plan. The data & information collected through base line survey shall be analyzed & database to be prepared on GIS/suitable MIS environment. Data will be put to use for various strategic designing & planning purposes.

iii. GIS mapping, Procurement of thematic layers and preparation of Watershed Development Plan:

Each watershed has unique characteristics & problems. It’s treatment & management would require careful consideration of various site specific factors like topography, nature, soil depth, soil cover, type of soil/rock, water absorbing capacity of land, rainfall intensity, land use etc. While planning of CACP, high resolution remote sensing satellite data would be utilized using GIS tools for finalizing contour maps for assessment of run-off & for identifying structures best suited for the location in the projects in addition to other thematic layers and digital elevation modeling.
Following thematic layers, including others, will be used:

In A0 size (Super imposed maps of desired thematic layers/maps as mentioned below on cadastral / khasra map and watershed Map in different permutation and combination as per requirement on the scale 1:10000 consolidated and on scale of 1:4,000; village wise)

a. Base Map (cluster, village, Gram Panchayat boundary, transport network, canals, settlements, key land marks & point of interest) with all the labels like village names, macro/micro ID etc.

b. Land Use & Land Cover (LU/LC) map showing single as well as double cropped area.

c. Contour map at 1 meter vertical interval with drainage & water bodies along with cluster boundaries.

d. Slope map.

e. Drainage Network Map.

f. Soil Map showing land capability classification.

g. Flow Accumulation Map.

h. L-section & Cross section of all drainage lines greater than 25m length at every 40 meter interval.

i. Proposed Land and Water Resources Development Map (Separate layers) showing all the proposed interventions under CACP.

iv. Assessment of water resources availability and its uses:

a. Various information like no. of tanks, wells, tube wells and existing water harvesting structures, seasonal pre & post monsoon water levels, storage capacity of tanks, yield of wells, water levels of representative wells/WHSs, pumping methods/hours, area irrigated by tanks/wells/WHS in different seasons, cropping pattern, irrigation practices (flood irrigation, drip, sprinkler etc.), water demand for agriculture, crop production, water demand for drinking, domestic, industries & quality of ground water, land-use pattern etc. will be collected.

b. Actual assessment of water resources availability within the cluster based on the analysis of long term hydro meteorological data (rainfall distribution pattern; water budgeting, runoff potential, water use efficiency etc.) & assess the utilizable water resources availability from all water sources (water harvest structures, ground water etc.) area for various purposes and also the projected demand. This assessment needs to be updated on yearly basis with reference to base year after the monsoon will be carried out.

c. Single & double cropped area using multi seasonal high resolution satellite data or other suitable method during the month of Sept. & Feb. of cluster area with collateral data available with concerning agencies/ department will be assessed.

d. Water balance exercise within the context of above two analysis & with due regard to existing water resources commitment of said cluster to the downstream catchments will be carried out. For this, visits of downstream areas & consultation with farmer could be undertaken.

e. Water use efficiencies from each of these sources/irrigation methods, detail the scope & potential of increasing the water use efficiency and the amount of potential water savings will be mapped out properly.

f. Water resources so obtained would form the basis for developing watershed management plan
g. Concerning line department with the coordination and support of concerning DPMU will prepare & submit detailed sub plan of CACP to the project.

v. Design, construction of hydraulic structures and hydrological monitoring network (HMN). Instruments like runoff recorder, sediment sampler, automatic rain gauge, drop spillway and instruments housing facility shall be provided.

a. The objective would be to study rainfall data & distribution pattern and suggest the number and location of Automatic Weather and Rain Gauge stations to be installed in the cluster area for monitoring of rainfall distribution pattern along with detailed design, drawings, cost estimates and other related documents based on the technical criteria, design specifications.

b. Number & types of hydraulic structures to be constructed both at the community level and individual farm level will be planned and finalized. These structures will mainly include, among others, percolation tanks, check dams, waste weirs, individual farm ponds, water harvesting structures, contours bunds, Tankas, Contour V-ditches, Staggered box typed trenches, khadins etc.

c. Engineering design, drawings and estimates of the identified structures as per prevailing BSR will be prepared & it will be ensured that communities are implementing the same in accordance with the directions of PMU & ensuring prescribed quality standards.

d. Designing of the HMN will include, among others, (i) site selection; (ii) establishment of automated weather stations; (iii) establishment of observation wells; (iv) silt observation posts and, (v) other necessary units; including type, drawings and cost estimates.

e. The communities will be trained on aspects of data collection & maintaining records of HMNs.

f. Water resource/ground water or other contextual legislations & regulatory frameworks shall be adhered while designing/proposing the strategy.

vi. Annual Crop Water Budgeting (CWB):

a. Existing methods of irrigation (flood irrigation, drip, sprinkler etc.) from various existing water sources, area covered under irrigation, assessment and analysis of the existing irrigation methodologies will be studied in order to devise measures to increase water use efficiency with considerable savings of water & develop detailed plan of action for increase water use efficiency for its implementation.

b. CWB exercises will be carried out on an annual basis to match the water resources availability with Rabi season crop plan & requirements for perennial crops.

c. Results of CWB exercise will be shared with the community on a regular basis & survey of the cluster are will be undertaken to determine the extent of adoption of decisions taken during CWB exercise.

d. Comparisons of the adoption rates, changes in the irrigation practices (scheduling, irrigation methodology, usages of water saving and conservation practices), water saved through CWB (both projected & actual) will be carried out on yearly basis.

e. To improve the adoption rates and irrigation practices based on above comparison plan will be prepared & submitted.
B. Activities on Arable Lands:

B-1 Arable Land Conservation Measures:

The important principles to be kept in view while planning measures for proper conservation of water are increasing the time of concentration & thereby allowing more runoff water to be absorbed, intercepting the long slope into short ones & protection against damage by excessive runoff. In broader way, it is a series of mechanical barriers to reduce the slope percentage.

a. Contour Bund / Field Boundary Bund:

It is one of the most commonly adopted indigenous technologies for in-situ moisture conservation. Contour bunds to be are constructed along the contours where ever farmers agree. If land is less or farmers are not allowing bunds on contours in the field, then, compromise contour bund called field / boundary bunds of about 45-60 cm height adjusted on the field boundary are constructed with table top cross section. Locally this practice is known as ‘Medbandi’ or ‘Dhorapali’. Bunds are stabilized by grasses of local palatable/perennial species to supplement the fodder needs for animals.

For the area having slope less than 6% & flatter lands with scanty /erratic rainfall contour bund is practiced. Contour bund can be adopted on all types of relatively permeable soils except the clayey or deep blank cotton soils. Main criterion for spacing of bunds is to intercept water before it gets the erosive velocity, slope, cropping pattern, SWC practice adopted.

If needed, suitably designed waste weir or provision for disposal of excess runoff is also kept, aiming at keeping the bunds safe under high rainfall events. Sometimes these bunds serve the dual purpose of demarcating property & conserving soil and moisture.

- Side bund: bunds are constructed at extreme ends of the contour bund, which are running along the slope and up to the submerged length.

- Lateral bund: Bunds are constructed along the slope in between two side bunds, to prevent concentration of water along one side and to break the length of contour bund.

b. Waste weirs: To protect contour / field bund from breaching & prevent crop damage, masonry outlet structures are constructed to drain away excess water. Proper outlet/ waste weirs provided in contour bunds alternate to avoid gully formation & increase travel path.

C. Mini Percolation Tanks (MPTs)- 30 to 40 per watershed of 500 hectares in the first and second order streams, if falling in the farmers' fields: This is an earthen activity in which mostly semi-circular bund is formed across the slope direction out of excavated soil. This is low cost activity as compared to cement check dams. It is essential to prepare the base of the earthen bund by removing the top soil, for a thickness of about 0.10 meter. The stripped soil can be deposited all along the downstream of the bund to be used later on for spreading over the bund.

d. Sunken pits in gullies in first and second order streams, if falling in the farmers' fields: The method of providing sunken pits in gullies was found to be useful, serving the twin purpose of erosion control in gullies, as well as increasing the recharge. A small rough stone apron in the bed of the pit, is provided to withstand the falling flow of water. The length of pit at the bed level can be about 4.00 meter and the clear distance from one pit to another pit can be 4.00 meters.

e. Diversion drains/channels and sump, for recharging open dug wells (FWC): In case the watershed area falls below the unprotected area or hilly area from which
uncertain amount of water comes and enters in the area, then the diversion channel is excavated to intercept the runoff from the area situated above & to conduct it safely to outlet. Sometimes, diversion drains are also dug to divert the flow of flowing water from the fields into the dead open well for re-charging purpose.

f. Dugout Farm Ponds: The farm ponds, at a lower elevation, are constructed to harvest the excess runoff after in-situ moisture conservation. Farm pond helps in providing supplemental irrigation as well as increasing cropping intensity. Size of farm pond & design would depend on rainfall, catchment area of farm, runoff data, slope, runoff water availability. Plastic lined farm ponds are cheaper & best suited on individual farms if the soil blow is permeable.

B-2 Arable Land Production Measures:

To get the more benefit from agriculture crop, it is very important to decrease the cost of cultivation and increase the production. To decrease the cost of cultivation, it is necessary to use complete available land for cultivation, use of latest implements so that time and cost is reduced. Integrated crop management demonstrations as detailed in Agriculture Component would lead to taking more than one crop in a year for increasing production and income.

For increasing production water management plays an important role. Efforts will be made to have more production and income for every drop of water. Arid horticulture offers uncommon opportunities in this respect and demonstrations will be led out on growing of vegetables and fruit crops through use of drip wherever farm ponds are constructed.

a. Contour Ploughing /cultivation in rainfed lands (FWC):- Contour cultivation will be promoted in all the fields so that moisture is conserved in-situ enabling uniform productivity. Fields are prevented of forming small gully due to water flow across the contours.

b. Strip and mixed cropping: The practice consists of growing crops in strips across the direction of the prevailing winds, alternating them with buffer strips of crops that are resistant to wind erosion, or leaving stubble mulch fallow. The number of strips and their width depends upon the type of soil and the height of the crop in the buffer strip. The strips of stubble or wind-resistant crops act as micro-windbreaks which reduce the velocity of wind. This tends to stop soil movement in the next buffer strip before it gets a long sweep which would result in soil moving from the entire field.

c. Green Manure Crops before the main Kharif season crops: Mulching is a useful activity to prevent evaporation during summer. Cultivation of green manure crops (may be some leguminous variety) during pre-kharif would be quite useful. The varieties could be sowing of guar, sun hemp, dhencha etc. Dried organic matter should be ploughed during kharif and little/basal doze of P2 O5 could be applied.

d. Cover crops in rain-fed lands during post Kharif for Rabi season crops & dry period: Only cost of seed will have to be provided and seed made available, for dibbling before the end of the crop season.

e. Trees on all boundary bunds of rain-fed lands with a small trench on either side, to prevent tree roots spreading horizontally or competing with crops: On the field boundaries of the farmers, trees of suitable varieties are planted. Small trench on both the sides of the bunds is provided so that roots of trees may not affect the growth of crop in nearby areas and moisture in the trenches is also available for the trees for better growth.

f. Agro Forestry including block plantation, shelter belts, sand dune stabilization:
(i) Agroforestry is a broad term encompasses symbiosis of silvi-culture, agriculture and livestock without much competitions and same time increasing the unit land production. If we see tree planting in agriculture fields it may be at the borer of the fields’ tree and crop in alternate rows or strips, Trees and trees mixture. Agroforestry is a farming system integrating crop and /or livestock with trees and shrubs. The resulting biological interactions provides multiple benefits i.e. diversified farm income, increased biological production, better water quality and improved habitat for both humans and wildlife.

(ii) Under block plantation, generally for energy & industrial wood or fodder, these blocks are raised in corner or marginal land where agriculture crop or other agro-forestry models are not economical. e.g. Acacia nilotica, A. tortalis, A. holosericea, Lucena leucocephala, Salvodora persica, Dichroistyachus sp., Eucalyptus sp.,

(iii) Shelter Belts: Wind erosion is measure problem in western and north western Rajasthan in about 12 districts having 67.5 % area of Thar Desert. Hot winds @ 30-40 km per hour blows and cover the agricultural land by sand. Wind erosion is major concern to protect the agricultural and stabilize the shifting sand dunes in these areas. The main methodologies to be adopted for the control of wind erosion includes sand dune stabilization, establishment of wind breaks and shelter belts, Adoption of different agro forestry models. The watershed management strategies in these areas revolves around these measures as they are primarily forms the basis for the basic environment for amelioration of micro environment in the area and agrarians activities.

(iv) Movement of sand dunes poses a serious threat to the productive agricultural lands, houses, roads and water courses, etc. and, therefore, it needs stabilisation which can best be done with vegetation. Basically, sand dune stabilisation techniques comprise four distinct processes:

   i. Protection against grazing by fencing the area
   
   ii. Establishment of micro windbreaks on the windward side of a dune in 5 m parallel strips, or in a 5 m chess board pattern
   
   iii. Afforestation
   
   iv. Sowing of grasses and transplanting (with the onset of monsoon) of adapted tree and shrub species raised in earthen bricks on the leeward side of the micro windbreaks.

   g. Installation of PVC pipe lines on farmers' field and sprinkler / drip irrigation from farm ponds: For irrigation purpose, for conveyance of water from water source to the potential spots of irrigation in the field, PVC pipe lines will be provided. This will prevent the evaporation loss. Apart from this micro irrigation systems like sprinkler / drip will also be provided to save the irrigation water and improve the water use efficiency.

   h. Raising Nurseries for fodder, timber, fuel wood and horticulture: In consultation with the farmers and as per demand of local vegetative material, nurseries will be established / promoted in the cluster area. Necessary support for raising the seedlings/saplings, fertilizer, water etc. will be provided. No expenditure on land rant/cost will be allowed.

C. Activities on Non Arable Lands:

   C-1 Non Arable Land Conservation Measures:

The area not suited to cultivation limits their use largely to pasture or forest. These lands have a great potential for producing fodder, fuel, fiber etc. To protect these lands
from further degradation, suitable SWC measures supplemented with proper afforestation are planned.

a. **Continuous Contour Trenches (CCTs)** V-shaped ditches strictly along contour, with side slope for cut section with MPTs at gully junctions to reduce the velocity of runoff. Bunds are constructed downstream along the trenches with material taken out of them. Main objective is to create favourable moisture conditions. Plants are put in trench along berm.

b. **Constructing the box shaped staggered trenches across the deeper slopes:** Staggered trenches are excavated trenching of shorter lengths in a row along the contour with interspace between them. In the alternate row, the trenches will be located directly below one another. The length of the staggered contour trenches could be 3 to 4 m with interspaces between them in the same row of about 2 to 3 m. The trapezoidal trenches of 0.3 to 0.5 m bottom width and 0.5:1 side slope are preferred.

c. **Fencing of Pasture Lands:** To mitigate the fodder requirement, pasture development is proposed. The encroachment is the main problem of pasture development. The pasture land is developed by fencing of the area either by ditch cum bund, vegetative, stone wall or other suitable fencing. Most commonly, in the watershed area, the available pasture land is protected by ditch cum bund fencing. From the excavated soil of the trench, the bund is prepared inside the area along the trench, so that the animals cannot step in from outside of the area into the area.

**C-2 Non Arable Land Production Measures:**

These lands are un-noticed and have got huge potential to become productive with a series of conservation and production measures.

a. **Tree plantation** on all un-cultivated Non arable / Pasture lands to develop a three tier canopy: Trees, Bushes and Grasses form the three tier canopy, which is extremely supportive in reducing the rain drop erosive effect causing soil erosion/loss. Apart from this canopy helps in reducing evaporation loss of water. In the watershed areas, particularly on pasture and un-cultivated lands, location specific and suited plantation is to be done

b. **Tree plantation** on slopes and banks of gully: Often the gully head are leading to upper productive areas with the onset of monsoon when flow occurs. The banks and heads of the gully areas can be better prevented from further deterioration and advancing by way of planting suitable forestry trees along the sides/banks or at the gully heads.

c. **Vegetative cover** (Agave) for gully slopes: Suitable vegetative cover is to be provided in the farmers' fields to protect the soil moisture from getting evaporated. This is a slow but serious phenomenon. The conserved moisture either can be utilized for Rabi crops, it will recharge the ground water or will be available in the sil so that next monsoon comes, it could support the soil zone to become saturated early and perinatal flows, on certain locations could be witnessed.

d. **Over seeding of grass seeds in pasture land areas:** Broad-casting of locally suited palatable grass seed like Sevan, Dhaman, Stylo Hameta etc. is done in the interspaces of the V-Ditches or on the bund of V-ditches. The grass development action comprises of direct dispersion, interception, energy dissipation and evaporation of falling rain drops.

**D. Drainage line treatment:**

a. **Mini Percolation Tanks (MPTs)** - 30 to 40 per watershed of 500 hectares in the first and second order streams, if falling in the farmers' fields: This is an earthen
activity in which mostly semi-circular bund is formed across the slope direction out of excavated soil. This is low cost activity as compared to cement check dams. It is essential to prepare the base of the earthen bund by removing the top soil, for a thickness of about 0.10 meter. The stripped soil can be deposited all along the downstream of the bund to be used later on for spreading over the bund.

b. **Big percolation tanks** in third and fourth order stream: When mini percolation tanks are constructed in all the first order streams, dips, valleys near ridge and sub-ridge boundaries, the need for bigger percolation may not be felt. There is no necessity for a cut-off trench for bunds up to 5 meter ht. Key trenched at the base may be avoided as they do not serve any useful purpose. To economize the cost and satisfy the requirements, the rough stone revetment may be limited to wave zone and near about. Instead of starting revetment from toe, it can be started from 2 meter below FTL and taken upto TBL.

c. **Check Dams** in second and third order streams with earthen dam in center and surplus weir on side (No check Dam in the main stream and no cement structure in the stream course). The earthen bund / check dams should not be constructed in the main stream where maximum flood **discharge will be very high**.

d. **Sunken pits** in gullies in first and second order streams: The method of providing sunken pits in gullies was found to be useful, serving the twin purpose of erosion control in gullies, as well as increasing the recharge. A small rough stone apron in the bed of the pit, is provided to withstand the falling flow of water. The length of pit at the bed level can be about 4.00 meter and the clear distance from one pit to another pit can be 4.00 meters.

e. **MPTs at head of gullies & upstream of sunken pits & drainage line treatments**: As like point a mentioned above.

f. Rubble stone **diversion weir** on the main stream, for gravity irrigation: The purpose of this structure is to divert the low flows and spring flows available in the streams to the gravity channels. When medium to high flow occur, they have to pass over the weir structure and the design has to take care of stability under such conditions. Mail channel on either side of the structure have to be taken along the contour giving the required slope.

g. **Restoring and de-silting very small tanks lying within the watershed**: This is an important activity, in which with little efforts, we can increase the capacity of the existing water resources. Suitable water surplusing arrangement for safe disposal of water can also be provided. Necessary surve is required for the purpose.

h. **Loose stone check dam**: The gully control structure will be constructed by locally available loose stone without any binding material. So these structures are called Loose Stone Check Dam. The gullies will be plugged by stone with height not more than 1m with upstream slope, nearly vertical and downstream slope 1.5:1. The depth of foundation will be kept about 0.4 m and with about 0.6 m inside the natural ground on each side to prevent flood water out flanking the structure. Upstream side of the structure will be filled by the soil at slope 2:1 with grasses.

i. **Construction of masonry structures**: In some places where vegetative measures and simple practice alone are inadequate to handle the concentration of water, permanent masonry structures structure will be provided.

j. **Gully control structures**- It consists of constructing earthen bunds of suitable dimension across the small nallah or gullies to hold the runoff water. Temporary storage of runoff against the bunds carries deposition of silt & water is drained off in controlled manner. The water impounding facilitates percolation of water, which otherwise will flow with intense velocity.
k. Construction of Water harvesting structures/Tanks: Where ever feasible small water harvesting structures called ponds / talai’s will be constructed. Repair, rehabilitation of old tanks & talai would be undertaken on priority.

l. Sub surface dams at the downstream of the watershed: This work has to be executed at a suitable place on the downstream side of the watershed. Geo-physical surveys have to be conducted to determine the exact location. Excavation of the trench for the sub surface dam may be done manually adopting a trench section, preferably during summer season. Puddle clay from the nearest tank bed has to be conveyed and filled in the trench for a width of 0.90 meter. The puddled clay has be mixed with water and made into plastic balls of about 0.40 meter diameter and deposited in the trench and trampled with legs. On either side of the puddle clay, an HDPE film of about 200 microns thick may be provided to ensure blanket cut-off wall. As the puddle clay wall comes up, earth filling on the sides has to be done. These are highly cost effective measure for ground water retention.

E. Consolidation of various works: The activities during consolidation period will cover:

a. Preparation of project completion report (PCR) with status of each intervention including details of funds available, bank account etc. & will be submitted to the Project.

b. Up-scaling and Documentation of successful experiences as well as lessons learnt for future use.

c. Strategy for management of developed natural resources.

d. Improving the sustainability of various interventions under the project.

e. NGO will help the MTAs/PRIs in formal allocation of user’s right over common property resources (CPRs) for sustainable utilization of developed natural resources.

f. Collection of user charges for CPRs;

g. Repair, maintenance and protection of CPRs;

h. Sustainable utilization of developed natural resources;

i. Involvement of GP/other institutions (as governance body) in addressing above aspects.

4. Project Management:

The major activities of the Project in CACP will be sequenced into following phases

<table>
<thead>
<tr>
<th>Name of Phase</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>I CACP Planning Phase</td>
<td>0-6 Months</td>
</tr>
<tr>
<td>II CACP Implementation Phase</td>
<td>7-54 Months</td>
</tr>
<tr>
<td>III Consolidation and Withdrawal phase</td>
<td>49-54 Months</td>
</tr>
</tbody>
</table>

(Sustainability during Implementation phase)

Beneficiaries Contribution:

Under RACP farmer's contribution is an integral part of project cost besides World Bank and State Government’s contribution in order to ascertain the belongingness of the local community.

(i) There will a beneficiary contribution of 10% for small and marginal farmers and 20% for others farmers in all the individual watershed activities and will be adjusted in the tranches of the installment as per Finance Management Chapter & shall be deposited in the RACP account.
(ii) These contributions would be acceptable in Cash/Labour/Material.

(iii) There will be no beneficiary contribution for activities on common / Panchayat land.

(iv) The CRP, MTA shall maintain the record of farmer’s contribution towards project costs as per directions given by DPMU/PMU.

**Expectations from the beneficiaries:**

(i) The farmer should be willing for construction of community farm ponds/ individual farm pond, sunken ponds, percolation tanks etc. as per the survey report.

(ii) The farmer should be ready to adopt strip/mix cropping for soil and water conservation.

(iii) He should be ready to for construction of small community watershed and it’s restoration etc. and contribute his share as envisaged under the project guidelines.

(iv) The farmer should be ready to work for water conservation i.e., bunding, furrow and installation of PVC pipes and drip irrigation from farm pond.

(v) The farmer should agree to follow general guidelines on soil and water conservation as recommended in the project area.

(vi) Preference would be given to small & marginal farmers.

**Post Project Sustainability:**

i. NGO in consultation with the DPMU & PIU will prepare consolidation & exit strategy, management plan for repair, maintenance & protection of developed common properties latest by first month of 3rd year of assignment.

ii. NGO will build up capacity of MTAs/PRIs to take over the task of operation & maintenance of assets created & make suitable administrative & financial arrangements for its maintenance and further development after the project period.

iii. On individual lands, beneficiary will be responsible for post project maintenance of works.

iv. On common / community /panchayat lands, the asset maintenance after the project period shall be taken up by MTAs with the earned amount separately in their bank account and/or with the support of panchayat funds in consultation with PRIs.

v. User charges, sales proceeds and disposal amounts of intermediate usufruct rights shall be deposited in the MTA’s bank account with separate records.

vi. Income earned from assets created under the project on common property resources shall also be credited in the designated bank account of MTA with separate records.

**Note:-**

(i) Preparation of Sub Plan of CACP related with various line department /NGO, community mobilisation in the specified template & Implementation arrangements for project implementation at Cluster and higher level shall be covered in separate chapters.

(ii) All the details of implementation methodologies shall be covered in the Operational Guidelines prepared for the clusters concerned.

**Supervision of Works:**

The supervision of the works is necessary to ensure technical standards & quality assurance. DPMU will supervise day to day execution of works executed by PIU/NGO/MTA/MTGs /UGs ensures that the works are executed as per approved design & specifications. PIU/NGO will ensure maintenance of all record at each site & made available to DPMU/PMU for inspection.
In addition, DPMU will monitor the quality of works at least once in week & ensure that works are carried out as per the approved action plan, design & specifications. He will record his observations in site register maintained by MTA/NGO. DPMUs will submit his inspection report to PMU on 5th of every month. PMU would communicate the observations recorded to him and he will take immediate corrective measures wherever required.

**Monitoring, Evaluation and Learning:**

A participatory, outcome & impact-oriented & user-focused Monitoring, Evaluation & Learning system would be put in place to obtain feedback & undertake improvements in planning, project design & implementation.

i. PMU will conduct regular meetings of PIUs / DPMUs / NGO to review the progress of the project.

ii. Regular monitoring of the project will be carried out at each stage. Online monitoring will be an important feature. Monitoring would include process & outcome monitoring.

iii. NGO will submit the progress reports in the prescribed formats on monthly, quarterly & annually to DPMU for monitoring & further submission to PMU. DPMUs will have one member exclusively responsible for monitoring of progress.

iv. PIUs will submit monthly progress report to the DPMUs / PMU.

v. Regular monitoring and supervision of NGO shall be done by the DPMU, Jaipur-1 and the PMU. The DPMU, Jaipur-1 will verify the performance of NGO as per norms/procedure decided by PMU. PIUs/NGOs work & performance shall be reviewed by a committee constituted for this purpose. This review committee will also guide & instruct PIUs/NGOs apart from DPMUs in accomplishing the assignment in desired manner. Review committee shall be comprised of Project Director, Chief Finance Controller, Project Coordinator-PMU-concerned and Manager (Procurement).

vi. The project may undertake evaluation through competent agency.

vii. Each evaluation will include physical, financial & social audit of the work done.

**Outcomes:**

The outcomes of the Projects shall be closely monitored by PMU & DPMU. For this purpose, separate formats will be developed by PMU. PMU/DPMU/PIU are expected to achieve following results by the end of the project period:

i. All works/activities that are planned for treatment of arable & non-arable lands in cluster area are completed with active participation & contribution of MTGs/UGs & community at large.

ii. MTAs/UGs/GPs have willingly taken over the task of operation & maintenance of assets created & made suitable administrative and financial arrangements for maintenance & further development.

iii. All the members including CRP of MTAs have been given orientation & training to improve their knowledge & upgrade technical/managerial and community organizational skills to a level that is appropriate for successful discharge of their duties & responsibilities on withdrawal of project.

iv. The increase in cropping intensity & agricultural productivity reflecting in overall increase in agriculture production.

v. Increase in income of farmers/landless labourers in the project area.

vi. Increase in groundwater table due to enhanced recharge by watershed interventions.
2. Ground water

Groundwater continues to be considered as a private and individual resource. Its development is mostly by individual or group of farmers with their own financial resources or with loans from financial institutions/banks and the Government provides financial support mainly through partially subsidized energy supply. Despite various I.E.C. efforts by the GoR, excessive withdrawal of groundwater continues which has resulted in regional imbalance and inequity amongst users. This has destabilized the aquifer system and resulted in unsustainable development. Indiscriminate ground water development has led to substantial ground water level declines both in hard rocks and alluvial areas threatening sustainability of this resource.

Considering the limitations of present groundwater management system, there is a need to develop a new groundwater management model that recognizes limitations of existing management system by individual. Groundwater occurs in an aquifer which has its own natural boundaries and does not necessarily follow the geographical boundaries like Administrative unit. Groundwater occurrence and movement are not limited to individual land holdings. Therefore, sustainable groundwater management system has to recognize an aquifer as a groundwater unit. The sustainable development and management of groundwater resources in an aquifer could be achieved through community participation. For this, all primary stakeholders in an aquifer have to collectively manage the groundwater resources through prioritize utilization of groundwater by different sectors like drinking water, agriculture, and industry, and allocate the available resources to each user sector for sustainable development. This requires regulating the demand particularly for agriculture sector.

Objective: The aim over time is to achieve sustainability of ground water resources (i.e. aquifers) selected and supported under the project. Achieving sustainability of groundwater sources is envisaged to take place through community-based approaches with public support striving to reach a situation over a meaningful period of time in which the annual water extraction from the aquifer is limited to the annual ground water recharge. This requires changes in ground water extraction rates as well as efficient on farm water usages including (among others):

a) an accurate measurement of ground water extraction in the aquifer
b) bringing a balance between water recharge and extraction over time
   • efficient use of ground water through:
     • Demonstration of water efficient technologies for irrigation (Drip & Sprinklers etc.) and
     • Promotion of high value agriculture as well as
     • Promotion of crops introduced and/or supported as part of improved crops rotation and management practices with lower water requirements.

In view of the state’s needs, the Community Based Aquifer Level Groundwater Management Model under RACP would be developed which recognizes limitations of
existing management system by individual and recommends an aquifer level groundwater management by the community. It is envisaged that objective of Model would be:

a. Community driven institutional Model to develop and test groundwater management approaches in an aquifer representing different groundwater utilization situations by the community (concerned stakeholder of ground Water) as well as acceptability by the community.

b. Information Education and Communication (IEC) campaign to create awareness of emerging problems and generate support from all stakeholders for groundwater management options to solve the identified problems.

c. Strengthening of community to develop scientific data base and enhance their analytical skills and technical capabilities essential to monitor groundwater conditions and understand the viability of various potential management options for sustainable groundwater management in an aquifer

d. Take up activities that would provide insight to key issues of groundwater management, options for legal framework and supporting regulations as an initiative for sustainable groundwater management.

**Component Design and Eligible Investments:**

Two sets of activities are envisaged for effective planning & implementation of the Ground Water Component. The first set of activities will involve following five components:

1. **Social Assessment:**
   As a first step towards developing an approach and plan for a community based groundwater management, it is essential to understand the ground situation with regard to supply and demand of groundwater, initiatives at the community level, and how the community could be involved to address these issues. For this purpose it is essential to carry out a detailed Social Assessment (SA) in the cluster area. The main aim of the exercise would be to identify the social issues associated with the proposed approach of community based groundwater management, understand its ramifications and problems. The results of the social assessment will form the basis to develop a strategy to involve local communities in the overall planning, implementing (including operation and maintenance of structures and management systems developed), and monitoring the project activity under the groundwater cluster. This will be done mainly through informed participation.

2. **Inventory surveys and technical analysis:**
   Ground water recharge is dynamic in nature and highly dependent upon the spatial and temporal variations of various inputs including rainfall and outputs from the system in terms of withdrawal, exchange with surface water streams and water bodies. The manifestation of these inputs and outputs and their resultant impact is measured in terms of water level changes. The Inventory surveys would include:

   a. Collect information on rainfall in the proposed cluster area and its distribution pattern.

   b. Collect hydrological information on all existing water storage related assets like dams, head works, canals, tanks, farm Ponds, Diggies, check dams, anicuts, and any other water harvesting and data on water storage, water delivery, command area during different seasons.

   c. The Detailed Hydro geological survey of 100% ground water extraction units during Pre-Monsoon, Post-Monsoon and Post-Irrigation and collect collate information pertaining to the Geology, Hydrogeology (water bearing formation (aquifer)), depth of wells, water levels, yield of wells area irrigated by the wells during different seasons i.e. Kharif, Rabi and Zaid to demarcate aquifer boundary.
d. Collect information on cropping pattern, irrigation practices, water demand for agriculture, crop area and production to estimate the water requirement of various crops.

e. Technical analysis would be carried out to determine the direction of seasonal (Pre, Post Monsoon & Post Irrigation period) groundwater flow, groundwater recharge & discharge area.

f. Chemical analysis in the cluster area would be carried out for agriculture purposes.

g. Geophysical investigations using appropriate resistivity method would be carried out in proposed area to demarcate & delineate the aquifer extension, thickness of aquifer and bedrock configuration.

h. Estimation of annual ground water resources availability within the cluster would be carried out based on the analysis of the long term hydro meteorological data and fluctuation data for current year pre-monsoon, post monsoon water levels monitored in the cluster area.

i. Estimation of village wise annual usages of the water resources for the drinking, domestic & industries using number of wells/tube wells in use, operational days and yield of wells in the cluster area and using demographic data for the area.

j. Estimate ground water availability for agriculture purposes within the context of annual availability of ground water and usages for drinking, domestic, industries and also with due regard to the projected Ground Water resources commitment for drinking & domestic purposes for the forthcoming twenty five (25). Demographic information for this purpose shall be used.

k. Estimate annual ground water draft using area irrigated by wells, yield of wells, cropping days, crop water requirement for different crops, fluctuation data for current year post monsoon & post irrigation water levels monitored in the cluster area.

l. High resolution Quick Bird satellite data for every September & February season of the cluster area will be used to assess single and double cropped area, cropping pattern; water spread areas of different surface water structures. This data would also be used to decipher drainage morph metric analysis, hydro-geomorphology, and changes in land use from time to time and also to prepare different maps/layers for the cluster area.

m. Select one representative wells on the grid of one sq kms after 100% well Inventory survey for monthly water level monitoring in consultation with Ground Water Department and respective DPMU. The gaps and deficiencies would also be identified. Piezometers will be installed to fulfil this gap.

3. Information Education and Communication (IEC) Campaign:

Results of surveys will provide basic and essential inputs for understanding the prevailing situation and designing the IEC strategy suitable to cluster area. It is necessary to develop consensus amongst all stakeholders in the aquifer area for their active participation in every decision making process and to create awareness about the need for groundwater management by the community. This would be achieved through an intensive Information Education and Communication (IEC) campaign to inculcate the sense of belonging among the community for all project activities. Individually addressed communication through participatory work between project and the local communities is important. The intensive IEC will create the social consensus, necessary to motivate the local water users to join and participate in the local groundwater management committees.

The specific IEC campaign would address following aspects.

i. The availability of water is limited and therefore, should be used efficiently.
ii. The limited water resources are still manageable to provide livelihood to the community as a whole if the community adopts various demand and supply side interventions and participatory approach.

iii. It is possible to maintain the present income if the groundwater resources are managed properly by the community who shall allocate the available water resources to different water uses.

iv. RainWater conservation is essential for sustainable development.

v. Effectively disseminate the technical inputs such as allocation of ground water for different uses, changes in water levels, water quality and management options, crop diversification suitable for local conditions.

vi. Installation of water use measurement devices (water meters) on all ground water withdrawal structures to regulate groundwater extraction and usage and monitoring of withdrawal of ground water for assessment of ground water resources.

vii. Low cost methods for improving on-farm water use efficiency such as alternate furrow irrigation, paired row irrigation, use of crop residues as mulches for reducing evaporation losses.

viii. Adopt possible mitigating measures i.e. switch over to efficient method of irrigation like drip and sprinkler, low water demand crops etc.

ix. Adopt crop diversification plan to shift from high volume low value crops to low volume high value crops, which require less inputs specially water. This would include adoption of horticulture crops and protected cultivation.

The IEC program will mobilize the community to come forward for managing the groundwater resources themselves and will create conductive environment necessary for the formation of local groundwater management organizations in the aquifer area for implementing the Project.

4. Installation of piezometers:

Piezometers are proposed to be constructed in the cluster area. Piezometers will be installed in the cluster area either out-sourcing or through Ground water Department as decided by the project for monitoring the groundwater levels and chemical quality of groundwater in the aquifer located at different depths. These piezometers will also help in assessing the impacts of groundwater recharge structures. Each piezometer will be installed with Telemetric Digital Water Level Recorder (DWLR).

5. Installation of Weather and Rain Gauge Station:

Weather station will be installed in the aquifer area for monitoring rainfall distribution pattern by the project as per World Bank Guidelines.

6. Data Management:

Database of the all components and subcomponent of the projected cluster area using GIS environment in ARC-Info software and prepare various thematic layers on 1:4000 scale and consolidated on 1:10000 scale required for preparation and Implementation of CACP. Suggestive some layers may be as under:

- Base Map with Aquifer boundary, village boundary, Gram Panchayat boundary, transport network, canals, settlements, Key Landmarks & Point of) with all the labels like village names.

- Land Use & Land Cover (LU/LC) Map showing single as well as double cropped area

- Hydro-geomorphology Map

- Contour Map at 1 m vertical interval Interest
• Slope Map
• Land Capability Classification Map
• Drainage Network Map
• Flow Accumulation Map
• L-section & Cross section of all Drainage lines greater than 25m length at every 40 meter interval.
• Water Table Contour Map 2 m vertical interval
• Depth to water Map 1 m vertical interval
• Bed Rock Configuration Map
• Ground water Electrical Conductivity (EC) zone with depth to water Map
• Isopach map of unconfined aquifer
• Land Resources as well as Ground Water Resources Management Plan Map showing proposed interventions under CACP using different color/sketches/labels with all the items in legend etc.

**Second set of activities** will involve effective **Ground Water Management.** It is a proper mix of supply side and demand control measures activities. A combination of this could be implemented in the cluster area. An alternative institutional model and develop legal framework or **social regulation at community level** to enable the community to manage the groundwater on an aquifer level which covers **entitlement of equitable groundwater for various users by a multitier participatory framework involving local communities and transforming the groundwater rights to GWMA.** The second set of activities will involve following four components:

1 **Supply side interventions**

1.1 Artificial Recharge Structures:

Supply side intervention activities are intended to augment run-off surplus into the aquifer and thereby increase its availability artificially. Rainfall is the main source of recharge into Aquifer. Artificial recharge efforts are basically aimed at augmentation of the natural movement of surface water into ground water reservoir through suitable civil construction techniques. Such techniques interrelate and integrate the source water to ground water reservoir and are dependent on the hydrogeological situation of the area concerned. The construction of recharge structures will be undertaken by GWMCs.

1.2 Scope for artificial recharge:

The scope for artificial recharge in an area is basically governed by the **thickness of unsaturated material available above the water table** in the unconfined aquifer. Contour maps prepared from the average post-monsoon water level data with suitable contour intervals can be used for assessment of available storage space. Aquifers best suited for artificial recharge are those, which absorb large quantities of water and release them whenever required.

1.3 Planning of Artificial Recharge:

The first step in planning the project is to demarcate the area of recharge. The artificial recharge of ground water is normally taken in following areas:

1. Areas where ground water levels are declining on regular basis.
2. Areas where substantial amount of aquifer has already been desaturated.
3. Areas where availability of ground water is inadequate in lean months.
4. Areas where salinity ingress is taking place.

1.4 Finalisation of Physical Plan for artificial recharge:

The finalization of physical plan for artificial recharge involves the following steps:

- Preparation of lay-out plan of the project area on an appropriate scale showing the locations of proposed structures and source of water conveyance systems.
- Determination of the number of structures required for recharge.
- Identification of tentative locations of proposed structures
- Community’s acceptance of the type and number of structures
- Preparations of design specifications and drawings
- Working out the time-schedules for completion of various stages of the scheme.
- Planning of financial aspects such as source of funds, allocations required at various stages etc.

1.5 Advantages of Artificial Recharge:

Artificial recharge is becoming increasingly necessary to ensure sustainable groundwater supplies to satisfy the needs of a growing population. The benefits of artificial recharge can be both tangible and intangible. The important advantages of artificial recharge are:-

- Subsurface storage space is available free of cost and inundation is avoided
- Evaporation losses are negligible
- Quality improvement by infiltration through the permeable media
- Biological purity is very high
- No adverse social impacts such as displacement of population, loss of scarce agricultural land etc
- Temperature variations are minimum
- Environment friendly, controls soil erosion and flood and provides sufficient soil moisture even during summer months
- Water stored underground is relatively immune to natural and man-made catastrophes
- Natural distribution system between recharge and discharge points
- Results in energy saving due to reduction in suction and delivery head as a result of rise in water levels

1.6 Implementation of Artificial Recharge Schemes:

Successful implementation of artificial recharge schemes will essentially involve the following major components

- Assessment of source water
- Planning of recharge structures
- Finalisation of specific techniques and designs
- Monitoring and impact assessment
- Financial and economic evaluation

1.7 Techniques of Artificial Recharge:
Once the areas requiring artificial recharge are identified, the next step is to decide on the appropriate techniques for recharging the aquifer. The synthesis of all available data relevant to ground water is the first step in this exercise. These data include:

- all sources of recharge like rivers, tanks, canals etc.
- rainfall distribution pattern,
- hydrogeological parameters with emphasis on lithological characteristics,
- nature of the terrain,
- intensity of ground water development and irrigation practices and
- chemical quality of surface and ground water etc.

Wide spectrums of techniques are in vogue to recharge ground water reservoir. The artificial recharge techniques too vary widely similar to the variations in hydrogeological framework. A few possible groundwater recharge techniques that could be selected by Community for implementation of Artificial Recharge Schemes depending upon their need and technical feasibility are as below:

1.8 **Surface Techniques:**

1.8.a **Ditch and Furrow Method:**

In areas with irregular topography, shallow, flat bottomed and closely spaced ditches or furrows provide maximum water contact area for recharge water from source. This technique requires less soil preparation than the recharge basins and is less sensitive to silting.

1.8.b **Percolation Tanks (PT)**

These are the most prevalent structures as a measure to recharge the ground water reservoir both in alluvial as well as hard rock formations. The efficacy and feasibility of these structures is more in hard rock formation where the rocks are highly fractured and weathered.

**Important Aspects of Percolation Tanks:**

a. A detailed analysis of rainfall pattern, number of rainy days, dry spells, and evaporation rate and detailed hydrogeological studies to demarcate suitable percolation tank sites.

b. In semi arid climate, the storage capacity of percolation tank is designed such that the water percolates to ground water reservoir by January since the evaporation losses would be high subsequently.

c. Percolation tanks are normally constructed on **second to third order stream** since the catchment so also the submergence area would be smaller.

d. The submergence area should be in uncultivable land as far as possible.

e. Percolation tank be located on highly fractured and weathered rock for speedy recharge. In case of alluvium, the boundary formations are ideal for locating Percolation Tanks.

f. The aquifer to be recharge should have sufficient thickness of permeable vadose zone to accommodate recharge.

g. The benefitted area should have sufficient number of wells and cultivable land to develop the recharge water.
h. Detailed hydrological studies for run off assessment be done and design capacity should not normally be more than 50% of total quantum of rainfall in catchment.

i. Waste weir or spillway is suitably designed to allow flow of surplus water based on single day maximum rainfall after the tank is filled to its maximum capacity.

j. Cut off trench is provided to minimise seepage losses both below and above nalla bed.

k. To avoid erosion of embankment due to ripple action stone pitching be provided upstream upto HFL.

l. Monitoring mechanism in benefitted as well as catchment area using observation well and staff gauges be provided to assess the impact and benefits of percolation tank.

1.8.c Modification of Village tanks as recharge structure:
Most villages have village ponds/ tanks to store rainwater for uses other than human consumption like livestock consumption and at the same time help in recharging groundwater in the aquifers in their vicinity.

1.8.d Check Dams / Cement Plug nala bunds:
Check dams are constructed across small streams having gentle slope and are feasible both in hard rock as well as alluvial formation. The site selected for check dam should have sufficient thickness of permeable bed or weathered formation to facilitate recharge of stored water within short span of time.

A series of small bunds or weirs are made across selected nala sections such that the flow of surface water in the stream channel is impeded and water is retained on pervious soil/tock surface for longer body. Nala bunds are constructed across bigger nalas of second order streams in areas having gentler slopes. A nala bund acts like a mini percolation tank.

Site Characteristic and Design Guidelines: For selecting a site for Check Dams/Nala bunds the following conditions may be observed.

a. The total catchment of the nala should normally be between 40 to 100 Hectares. Though the local situations can be guiding factor in this.

b. The rainfall in the catchment should be less than 1000 mm/annum.

c. The width of nala bed should be at least 5 metres and not exceed 15 metres and the depth of bed should not be less than 1 metre.

d. The soil down stream of the bund should not be prone to water logging and should have pH in between 6.5 to 8.

e. The lands downstream of Check Dam/bund should have irrigable land under well irrigation.

f. The Nala bunds should be preferable located in area where contour or graded bunding or lands have been carried out.

g. The rock strata exposed in the ponded area should be adequately permeable to cause ground water recharge through ponded water.

h. Nala bund is generally a small earthen dam, with a cut off core wall of brick work, though cement bunds/plugs are now prevalent.
i. For the foundation for core wall a trench is dug 0.6 m wide in hard rock or 1.2 metres in soft rock of impervious nature. A core brick cement wall is erected 0.6 m wide to stand atleast 2.5 metres above nala bed and the remaining portion of trench is back filled on upstream side by impervious clay. The core wall is buttressed on both sides by a bund made up of local clays and on the upstream face, stone pitching is done.

j. Normally the final dimensions of the Nala bund are; length 10 to 15 metres, height 2 to 3 metres and width 1 to 3 metres, generally constructed in a trapezoidal form. If the bedrock is highly fractured, cement grouting is done to make the foundation leakage free.

1.8.e Gabion Structure:
This is a kind of check dam being commonly constructed across small stream to conserve stream flows with practically no submergence beyond stream course. The boulders locally available are stored in a steel wire. This is put up across the stream's mesh to make it as a small dam by anchoring it to the streamside. The height of such structures is around 0.5 m and is normally used in the streams with width of about 10 to 15 m. The excess water overflows this structure storing some water to serve as source of recharge.

1.8.f Scattered pits:
Staggered trenches are excavated trenches of shorter lengths in a row along the contour with interspace between them. In the alternate row, the trenches will be located directly below one another. The length of staggered trenches is 3-3.65 m with interspaces between them in same row of about 2.4 to 3 m.

1.8.g Anicuts/Tanks:
Where ever feasible small water harvesting structures called Anicut, ponds/ talai’s are constructed. Suitable site selection is important.

1.8.h Farm Ponds:
The substantial runoff will be lost from the cluster during the rainy season. This runoff not only lost but it will promote soil erosion in the cluster. So this runoff should be harvested in the cluster it-self whether it is private land or community land. The farm ponds will be constructed in private land to harvest the excess runoff after in-situ moisture conservation.

1.9. Sub- surface Techniques:
Subsurface techniques aim at recharging deeper aquifers that are overlain by impermeable layers, preventing the infiltration from surface sources to recharge them under natural conditions. The most common methods used for recharging such deeper aquifers are a) Injection wells or recharge wells, b) Recharge pits and shafts, c) Dug well recharge, d) Borehole flooding and e) Recharge through natural openings and cavities.

1.9.a Injection Wells or Recharge Wells:
Injection wells or recharge wells are structures similar to bore/tube wells but constructed for augmenting the ground water storage in deeper aquifers through supply of water either under gravity or under pressure. The aquifer to be replenished is generally one with considerable desaturation due to overexploitation of ground water. Artificial recharge of aquifers by injection wells can also be done in coastal
regions to arrest the ingress of seawater and to combat problems of land subsidence in areas where confined aquifers are heavily pumped.

**Site Selection and Design Criteria:**

i) A proper understanding of the aquifer geometry is the most important factor in implementation of successful recharge schemes through injection or recharge wells. Detailed studies of the vertical and lateral extents of the aquifer and its characteristics are necessary prerequisites for such schemes. Grain size distribution of granular aquifers is another important parameter in the case of sedimentary aquifers.

ii) Recharge through injection wells increases chances of clogging of well screens and aquifer material, resulting in decreased injection rates. Clogging may be caused by suspended particles and air bubbles in the source water, formation of chemical precipitates in the well, source water or aquifer material, proliferation of bacteria in and around the injection well and swelling and dispersion of clay in the aquifer being recharged. Clogging may be minimized by proper treatment and removal of suspended material from source water, chemical stabilization and bacterial control. Using non-corrosive materials for pipelines and well casings may minimize clogging by corrosion products. Chlorination of source water prevents development of bacterial growth. Acid treatment helps in removing calcium carbonate precipitates from the gravel packs and aquifers. Periodic development of wells through surging, swabbing and pumping can considerably improve the efficiency and life of injection wells.

iii) As clogging increases the well losses considerably, the efficiency of injection wells should be taken as 40 to 60 percent as compared to pumping wells of similar design in the same situation.

iv) Adequate care should be taken to ensure that the water being used for recharge is not contaminated. The water being recharged should be compatible with the formation water to avoid any precipitation and resultant clogging. The relative temperatures of source and formation waters also affect the recharge rate.

v) For optimum benefits, it is advisable to have injection – cum – pumping wells to be used both for ground water recharge and extraction under favourable conditions.

**1.9.b Gravity Head Recharge Wells**

In addition to specially designed injection wells, existing dug wells and tube/bore wells may also be alternatively used as recharge wells, as and when source water becomes available. In areas where considerable de-saturation of aquifers have already taken place due to over-exploitation of ground water resources resulting in the drying up of dug wells and lowering of piezometric heads in bore/tube wells, existing ground water abstraction structures provide a cost-effective mechanism for artificial recharge of the phreatic or deeper aquifer zones as the case may be.

**Site Characteristics and Design Guidelines**

i) In areas where excess surface water is available during rainy season and the phreatic aquifers remain unsaturated, surface water can be pumped into the dug wells for augmentation of ground water resources. ii) Wells with higher yields before getting dried up due to the de- saturation of aquifers should be selected for recharge as they prove to be more suitable for ground water recharge when compared to low- yielding wells. iii) The recharge head available in gravity head recharge wells is the elevation difference between the surface water level in the feeder reservoir /tank and the elevation of water table or piezometric head. The recharge rates in such cases are
likely to be much less when compared to pressure injection and will also keep on reducing with build-up of the water table in the aquifer. iv) Pumping of wells during periods of non-availability of recharge water helps in removing the silt that may enter the well during recharge. However, more rigorous development may be essential in the case of deep bore/tube wells v) Care should be taken to ensure that the source water is adequately filtered and disinfected when existing wells are being used for recharge. The recharge water should be guided through a pipe to the bottom of well, below the water level to avoid scouring of bottom and entrapment of air bubbles in the aquifer.

1.9.c Recharge Pits

Recharge pits are normally excavated pits, which are sufficiently deep to penetrate the low-permeability layers overlying the unconfined aquifers. They are similar to recharge basins in principle, with the only difference being that they are deeper and have restricted bottom area. In many such structures, most of the infiltration occurs laterally through the walls of the pit as in most layered sedimentary or alluvial material the lateral hydraulic conductivity is considerably higher than the vertical hydraulic conductivity. Abandoned gravel quarry pits or brick kiln quarry pits in alluvial areas and abandoned quarries in basaltic areas can also be used as recharge pits wherever they are underlain by permeable horizons. Nalah trench is a special case of recharge pit dug across a streambed. Ideal sites for such trenches are influent stretches of streams. Contour trenches, which have been described earlier also belongs to this category.

Site Characteristics and Design Guidelines

i) The recharging capacity of the pit increase with its area of cross section. Hence, it is always advisable to construct as large a pit as possible. ii) The permeability of the underlying strata should be ascertained through infiltration tests before taking up construction of recharge pits. iii) The side slopes of recharge pits should be 2:1 as steep slopes reduce clogging and sedimentation on the walls of the pit. iv) Recharge pits may be used as ponds for storage and infiltration of water or they may be back-filled with gravel sand filter material over a layer of cobbles/boulders at the bottom. Even when the pits are to be used as ponds, it is desirable to provide a thin layer of sand at the bottom to prevent the silt from clogging permeable strata. v) As in the case of water spreading techniques, the source water being used for recharge should be as silt-free as possible. vi) The bottom area of the open pits and the top sand layer of filter-packed pits may require periodic cleaning to ensure proper recharge. Recharge pits located in flood-prone areas and on streambeds are likely to be effective for short duration only due to heavy silting. Similar pits by the sides of streambeds are likely to be effective for longer periods. vii) In hard rock areas, streambed sections crossing weathered or fractured rocks or sections along prominent lineaments or intersection of lineaments form ideal locations for recharge pits.

1.9.d Indirect Methods

Indirect methods for artificial recharge to ground water does not involve direct supply of water for recharging aquifers, but aim at recharging aquifers through indirect means. The most common methods in this category are induced recharge from surface water sources and aquifer modification techniques.
Induced Recharge

Induced recharge involves pumping water from an aquifer, which is hydraulically connected with surface water to induce recharge to the ground water reservoir. Once hydraulic connection gets established by the interception of the cone of depression and the river recharge boundary, the surface water sources starts providing part of the pumping yield. Induced recharge, under favourable hydrogeological conditions, can be used for improving the quality of surface water resources due to its passage through the aquifer material. Collector wells and infiltration galleries, used for obtaining very large water supplies from riverbeds, lakebeds and waterlogged areas also function on the principle of induced recharge.

In hard rock areas, abandoned buried channels often provide favourable sites for the construction of structures for induced recharge. Check dams constructed in the river channel upstream of the channel bifurcation can help in high infiltration to the channel when wells located in the channels are pumped with high discharge for prolonged periods.

Design Guidelines

i) Quality of source water, hydraulic characteristics and thickness of aquifer material, distance of the pumping wells from the river and their pumping rates are the important factors controlling the design of schemes for induced recharge. ii) For implementation of successful induced recharge schemes from stream channels, pumping wells should be selected at sites where water in the streams has sufficient velocity to prevent silt deposition. iii) Dredging of channel bottom in the vicinity of the existing pumping wells may have to be carried out periodically to remove organic matter and impervious fine material from the beds of the channel. iv) For wells constructed in unconfined alluvial strata for induced recharge, the lower one-third of the wells may be screened to have optimum drawdowns. In highly fractured consolidated rocks, dug wells penetrating the entire thickness of the aquifer should be constructed with lining above the water table zone and the curbing height well above the High Flow Level (HFL) of the stream.

1.9.e Dug Well Recharge:

In alluvial as well as hard rock areas, there are thousands of dug wells which have either gone dry or the water levels have declined considerably. These dug wells can be used as structures to recharge. During rainy seasons, a substantial quantity of rainwater is lost as runoff. If this runoff is diverted into a pit constructed at a lower elevation in the area and from there, after filtration, induced into an existing well, it would then enhance the recharge to the aquifers. The ground water reservoir, storm water, tank water, canal water etc. can also be diverted into these structures to directly recharge the dried aquifer. By doing so the soil moisture losses during the normal process of artificial recharge, are reduced. The recharge water is guided through a pipe to the bottom of well, below the water level to avoid scoring of bottom and entrapment of air bubbles in the aquifer. The quality of source water including the silt content should be such that the quality of ground water reservoir is not deteriorated.

1.9.f Recharge Shaft:

These are the most efficient and cost effective structures to recharge the aquifer directly. In the areas where source of water is available either for some time or perennially e.g. base flow, springs etc. the recharge shaft can be constructed.
site characteristics and design guidelines: -

To be dug manually of the strata is non-caving nature.

If the strata are caving, proper permeable lining in the form of open work, boulder lining are should be provided. The diameter of shaft should normally be more than 2 m to accommodate more water and to avoid eddies in the well.

In the areas where source water is having silt, the shaft should be filled with boulder, good and sand from bottom to have inverted filler. The upper most sandy layer has to be removed and cleaned periodically. A filter to be provided before the source water enters the shaft.

When water is put into the recharge shaft directly through pipes, air bubbles are also sucked into the shaft through the pipe which can choke the aquifer. The injection pipe should therefore be lowered below the water level, to avoid this.

1.9. g Ground Water Dams or Sub-Surface Dykes or Underground Bandharas (UGB):

These are basically ground water conservation structures and are effective to provide sustainability to ground water structures by arresting sub surface flow. A ground water dam is a sub-surface barrier across stream which retards the natural ground water flow of the system and stores water below ground surface to meet the demands during the period of need. The main purpose of ground water dam is to arrest the flow of ground water out of the sub-basin and increase the storage within the aquifer.

The underground dam has following advantages: -

• Since the water is stored within the aquifer, submergence of land can be avoided and land above reservoir can be utilised even after the construction of the dam.
• No evaporation loss from the reservoir takes place.
• No siltation in the reservoir takes place.
• The potential disaster like collapse of dams can be avoided.
• The aquifer to be replenished is generally one which is already over exploited by tube well pumpage and the declining trend of water levels in the aquifer has set in. Because of the confining layers of low permeability the aquifer can not get natural replenishment from the surface and needs direct injection through recharge wells.
• In alluvial areas injection well recharging a single aquifer or multiple aquifers can be constructed in a fashion similar to normal gravel packed pumping well. The only difference is that cement sealing of the upper section of the well is done in order to prevent the injection pressures from forcing leakage of water through the annular space of borehole and well assembly.
• In hard rock areas casing and well screens may not be required. An injection pipe with opening against the aquifer to be recharged may be sufficient. However, in case of number of permeable horizons separated by impervious rocks like vesicular basalts or cavernous limestones, a properly designed injection well may be constructed with slotted pipe against the aquifer to be recharged.
1.10 Monitoring Mechanism for Artificial Recharge Projects:

The monitoring of water levels and water quality is of prime importance in any scheme of artificial recharge of Ground Water.

1.11 Water Level Monitoring:

Network of observation wells is used to study the ground water flow pattern and temporal changes in potentiometric head in the aquifer.

The objective of monitoring system is to study the effect of artificial recharge on the natural ground water system. The periodic monitoring of Water Levels can demarcate the zone of benefit.

1.12 Impact Assessment:

The impact assessment of Artificial Recharge schemes can generally be enumerated as follows:

- Conservation and harvesting of surplus monsoon runoff in ground water reservoir which otherwise was going un-utilised outside the watershed/ basin and to sea.

- Rise in ground water levels due to additional recharge to ground water. In case where continuous decline of ground water level was taking place, a check to this and/or the intensity of decline subsequently reduces. The energy consumption for lifting the water also reduces.

- The ground water structures in the benefitted zone of artificial structures gains sustainability and the wells provide water in lean month when these were going dry. The domestic wells will become sustainable and many of the areas become tanker free.

- The cropping pattern in the benefitted zone will undergo marked change due to additionally of ground water and cash crops will start growing. Orchards which went dry earlier due to ground water scarcity may rehabilitate and new plantation is grown.

- Green vegetation cover may increase in the zone of benefit and also along the structures due to additional availability of soil moisture.

- The quality of ground water may improve due to dilution.

- Besides the direct measurable impacts, the artificial recharge schemes will generate indirect benefit in terms of decease in soil erosion, improvement in fauna and flora, influx of migratory birds, etc. Besides, the social and economic status of farmers of benefitted zone will also substantially improve due to increase in crop production.

2 Demand control measures:

Selection of specific activities suitable to local conditions and acceptable to the community for initiating groundwater management. Unless water demands are controlled, augmented supplies made available through groundwater recharge structures are likely to be utilized by expansion in agricultural and other uses. Some of the activities which can help to reduce the groundwater demand are:
2.1 Registration of existing ground water extraction units with GWMA:

Registration of existing ground water extraction units with GWMA to regulate groundwater development.

2.2 Installation of water use measurement devices (water meters):

Installation of water use measurement devices (water meters) on all ground water withdrawal structures to regulate groundwater extraction and usage and monitoring of withdrawal of ground water for assessment of ground water resources.

2.3 Switch over to efficient method of irrigation (drip and sprinkler):

The farmers in the cluster area would be motivated and encouraged to switch over from flow irrigation method to more efficient pressure irrigation methods like sprinkler and drip which saves more than 50% of irrigation water demand. Similarly, farmers would be educated to adopt ridge and furrow method of irrigation instead of basin and flow irrigation system to reduce groundwater use.

2.4 Adoption of horticulture crops instead of high water consuming crops:

Studies have indicated that pressure irrigation system like sprinkler and drip, adopted for horticulture and high water demand crops reduces the water requirements up to 50% to 75% compared to flow/basin irrigation. Hence there exists good scope to promote horticultural crops.

2.5 Switching over to low water demand crops:

As a part of demand side management strategy, the farmers in the area would be discouraged to grow high water demand crops and switch over to the other low water demand crops which could give them similar level of income. This would also be a part of the IEC campaign in the cluster areas.

2.6 Activity Display Board:

As a part of demand side management strategy the Activity Display Board will be installed at village level.

2.7 Crop Water Budgeting:

Water budgeting has been useful in ensuring sustainability of Agriculture, domestic purposes for human and livestock in the village. Village level water budgeting and auditing practices involve assessment of total amount of water available in the area of interest on annual basis, total demand for all uses and based on balance Ground Water availability, the cropping pattern is being decided locally.

3 Training and capacity building:

Results of surveys will provide basic and essential inputs for understanding the prevailing situation and designing the Training and capacity building strategy suitable to cluster area. The training is very significant activity towards achieving project development objective under RACP. It is necessary to develop consensus amongst all stakeholders in the aquifer area for their active participation in every decision making process and to create awareness about the need for groundwater management by the community. This would be achieved through an intensive training and capacity building campaign to inculcate the sense of belonging among the community, farmer’s women as well as project staff or all project activities. Individually addressed communication through participatory work between project and the local communities is important. To facilitate such communication prepare training and capacity building in an effective manner using local language. The intensive training and capacity building will create the social consensus, necessary to motivate the local water users to join and participate in the local groundwater management committees. **Time bound and regular training programs would have to be required under the project.** The specific training and
capacity building campaign would include Mass awareness Camps, Orientation programs, Capacity building, Advance training, Exposure visits etc. and address following aspects:

- Data recording and monitoring of water levels and management of the data and O&M of water meter
- Motivate and encouraged the farmers for promoting water efficient irrigation techniques such as sprinklers and drips.
- Adopt ridge and furrow method of irrigation instead of basin and flow irrigation system to reduce groundwater use.
- Shift from high volume low value crops to low volume high value crops
- Community participation in groundwater conservation and management
- Prepare Groundwater Use Plan for allocation of groundwater for different purposes and regulate withdrawal of groundwater in the aquifer.
- Monitor groundwater conditions by periodical monitoring of the water levels, area under different crops and other water related parameters to estimate ground water resources on an annual basis.
- GW budgeting based restriction to control irrigated area expansion.
- Installation of water meters on wells/tube wells for measurement of extraction of GW for sustainable use in the cluster area.
- Preparation of crop water budgeting & plan for the aquifer area based on the available groundwater recharge very year.
- Water rights and water markets
- Legal aspects of groundwater development
- Economically and institutionally sustainable over the project period.
- Asset management and maintenance task and made suitable administrative and financial arrangements for their maintenance and further development.
- Protection, development, conservation, equitable use of groundwater in the aquifer.
- Exposure visits of progressive farmers and Community to explore their knowledge as well as experiences about the technical and social innovations and successful work/project.

4 Social Regulation at Community level:

- Enable the community to manage the groundwater on an aquifer level which covers entitlement of equitable groundwater for various users by a multtier participatory framework involving local communities and transforming the groundwater rights to GWMA. Stakeholder participation in ground water management is essential for the following reasons:
  - Management decision taken unilaterally, without social involvement it is impossible to implement
  - Management activities like monitoring, inspection and fee collection to be carried out more effectively through cooperative efforts
- Ground water management decisions taken with the participation of stakeholders should help to bring:-
  - social benefits, because they tend to promote equity among users
  - economic benefits, because they tend to optimize pumping and reduce energy costs
  - technical benefits, because they usually lead to better estimates of water abstraction
4.1 Suggestive activities for Social regulations at community level are as below:

a. Ground water is a social, Economic and Environment goods hence declare as common property.

b. Registration of all ground water withdrawal structures with the Ground Water Management Association (GWMA).

c. Act according to the Central Ground water Authority Rules and Regulation issued from time to time for Notified and Non-notified areas.

d. No new well/bore well to be drilled without prior permission of GWMA.

e. Equitable assess of Ground water to all community.

f. Increase ground Water by conservation and recharge.

g. One day rest for well/tube well for saving of ground water and electricity both.

h. Create drinking water access to entire community.

i. Assessment of economic value of ground Water for taking appropriate resource allocation and management decision.

j. Water Rights in the form of Well permits and volumetric use rights to all the families in the aquifer area.

k. Water selling possibilities for allocated Ground Water.

l. Agriculture Water management through Technological interventions, Cropping system change, Growing of high productivity crop with per unit water, Application of Micro-irrigation system with less water consumption per unit of land.

m. Community self-imposed GW budgeting based restriction to control irrigated area expansion Ground Water abstraction charges. GW abstraction charges should be fixed much higher than true value.

n. Ground water abstraction through wells in sequences just like WARABANDI.

3. Canal irrigated clusters

From the reservoirs water is supplied to the command area farmers through a canal system. The canal system is constituted by main canal, branch canal, distributary canal and through minors & sub minors it reaches in the fields of command area farmers through outlets. The canal systems are made to cater the available water to command area farmers. Due to old canal systems and inadequate canal structures a huge quantum of water is lost in the system. As the huge change in climatic conditions the availability of water in the reservoirs is badly affected which resulted less availability of water to command area farmers.

To utilize the available water in the reservoir judiciously, under The Rajasthan Farmers Participation In Management of Irrigation Systems Act, 2000 (RFPMIS) Water Users Organizations have been set up and is under progress in canal irrigated areas under major dams by Water Resources Department.

2. Objective:

The objective under canal irrigated clusters supported under the RACP is to demonstrate the feasibility of agriculture water savings for use outside of the sector. In case of canal irrigated clusters, therefore, the focus will be to reduce the water foot print in agriculture (without reducing the present area under irrigation nor the cropping intensity) through improving the water use efficiencies at all levels of the system, and using the water thus saved to other sectors of water uses (such as drinking water).
The emphasis is on construction of diggies and providing sprinkler and drip for saving in water in agriculture. Another approach would be to shift from high water low income crops to low water high income crops specially introduction of vegetables and fruit plants. Efforts will be made to reduce conveyance losses on and off farm. Efficient system of water management will be implemented in the area which includes use of drip and sprinkler in the area for increasing productivity and production. Demonstrations will be laid and during first phase of the project and further expansion of the area will be undertaken later. The coverage would be such that there is sizable savings in irrigation water. Rehabilitation of distributaries and minors will be undertaken for saving in seepage loss.

In the selected canal irrigated areas the rehabilitation / modernization of canals, canal structures such as offtake structures / gates, syphons aqueducts, falls, escapes, canal crossing bridges, construction of desired new structures and installation /modernization of measuring devices & field outlets would be done. It will improve the conveyance efficiencies of the canal system and the availability of water savings apart from Agriculture may be used outside of the sector (without reducing the present area under irrigation nor the cropping intensity).

Following clusters are proposed to be undertaken for the water investment in the surface water (canal irrigation) cluster:

(i) Gudha irrigation scheme cluster, District Bundi region Kota having CCA - 11380 ha Agro-climatic Zone; - V (Humid south eastern plain)

(ii) Z distributary of Gang Canal system, District Sri Ganganagar having CCA - 12218 ha. Agro-climatic Zone -IB (Irrigated north western plain)

(iii) Orai and Bassi irrigation schemes District Chittorgarh, having CCA - 12510 ha. Agro-climatic Zone-IVA

(iv) LMC system of Jakham Irrigation Project District Pratapgarh, having CCA - 19529 ha. Agro-climatic Zone- IVB

(v) Phoolasar distributary of Charanwala Branch of Indira Gandhi Nahar Pariyojna stage 2, District Bikaner having CCA - 17970 ha. Agro-climatic Zone-IC.

(vi) Kheruwala distributary of Charanwala Branch of Indira Gandhi Nahar Pariyojna stage-2, District Jaisalmer having CCA – 20965 ha. Agro-climatic Zone IC

3. Eligible Investments:

A. Institutional activities:

i. Formation of WUOs

ii. Bench marking and water auditing

iii. Providing permanent offices to WUOs

iv. Office equipment’s to WUOs (computer, hardware/ software etc.)

v. NGO support to WUOs

vi. Training to WUOs

B. Physical activities:

i. Rehabilitation / modernization of canal system
ii. Rehabilitation / modernization of structures (such as offtake structures / gates, syphons aqueducts, falls, escapes, canal crossing bridges, construction of desired new structures)

iii. Installation / modernization of measuring devices & field outlets

C. Water Management activities:
   i. Construction of diggies
   ii. Installation of micro irrigation system
   iii. Assets management.

D. Operation support Activities:
   i. Assets management
   ii. Operational cost

E. On-farm Activities:
   This will include construction of diggies, provision of drip & sprinkler irrigation system as appropriate/needed. In addition adoption of alternative cropping pattern/diversification will be the core activity to reduce water use.

4. Planning:
   i. Community Participation:
      a. Involving command area farmers to understood the ownership of the canal system and sharing the needs for updation of the system.
      b. Interventions supported by the local stakeholders / community of cluster.
   ii. Base Line Surveys:
      a. Detailed survey and investigation including baseline survey, socio economic status, farmer’s profile (small, medium, large) in the villages of the cluster.
      b. Collection of data on soil profile, soil & its fertility status, seed replacement rate, fertilizer consumption and its availability, present marketing status, land-use pattern, soil type specifically infiltration rate and field capacity and other information required for the proposed cluster area.
   iii. Community Mobilization:
      a. Awareness campaigning through individual contact, small group meetings, mass meetings, community envisioning, vision validation, other IEC activities etc.
      b. Identification of affinity members; land based members; activity based members and activity based groups (Multi Task Groups) by involving farmers (about 15-20 members) of nearby fields/areas of project as per project guidelines.
      c. Assist / facilitate groups in selection of group representative, identification of group activities with particular emphasis on group marketing.
      d. Assist WUOs for various activities, including but not limited to, collecting data from hydrological monitoring system, book-keeping, Girdawari (compilation of farmer wise cropped area for water charges), collection of water charges,
conducting participatory crop water budgeting, assisting in promoting of Warabandi in the command area, assisting the Regional Technology Centre (RTC) for attending animal etc.

e. Social mapping using PRA techniques and tools.

iv. Assistance to Farmers Organizations:

a. Assist in functioning of WUAs.

b. Federating the WUAs and its sub committees/MTGs into Producer Company based on activities.

v. Water resources availability and its uses:

a. Water resource assessment is aimed to understand and assess the surface water availability and uses for various sectors including agriculture, domestic and industrial. This will help in identification of opportunities for water savings, increasing water based agricultural productivity.

b. Studying all the existing methods of irrigation (flood irrigation, drip, sprinkler etc.)

vi. Rehabilitation / modernization of canal system:

c. Diagnostic analysis through walkthrough survey of the canal network along with WUA’s to identify and prioritization of the activities of rehabilitation/modernization of canals up to outlet. Also access the need of rehabilitation/modernization or construction of canal structures i.e. siphons, aqueducts, escape channels, service roads, falls, VRB, measuring devices, field outlets, WUA buildings etc.

d. Carry out the detailed survey of existing canal system as per need for execution of rehabilitation / modernization of canal system showing position of outlets, structures, falls, VRBs etc.

e. Analyze the existing canal system and propose augmentation of the canal system / distribution network up to the outlet by designing the hydraulic efficient lined canal sections with the desired canal structures ensuring the water availability judiciously to the entire command area.

f. Carry out the necessary geo-technical & soil investigation for the existing canal system and desired new structures.

g. Preparation of design & drawings for modernizing the canal system

h. Checking of engineering designs & drawings and the planning network.

i. Preparation of cost estimates of the components including O&M Plan for the Project.


k. Preparation of Phase wise Implementation Schedule to execute the project components as per approved DPR.

5. Execution of Civil Constructions Activities:

i. Preparation of various tender packages following the World Bank procedures for floating tenders.
ii. Evaluation of received tenders and award the contract as per World Bank concurrence.

iii. Supervision of all civil constructions as per approved drawings & designs with quality assurance.
### RAJASTHAN AGRICULTURE COMPETITIVENESS PROJECT (RACP)

**Water Resources Department**

**Implementation Phasing**

<table>
<thead>
<tr>
<th>S. N</th>
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Component 1B: Technology transfer and market led advisory services

Technology transfer and market-led advisory services will be supported by Agriculture and Horticulture Departments who will undertake productivity promoting activities aiming to provide alternative marketing channels in addition to the existing regulated wholesale (APMC) markets and link farmers to the alternative markets for capitalizing on the emerging agricultural marketing opportunities, improving soil moisture regimes and on-farm water use efficiency, increase production and permit sustainable intensification and diversification of cropping patterns, post-harvest management, cleaning, grading, packaging, and limited processing and value addition. The project will finance (a) the demonstration and adaptation of location-specific soil and water conservation practices; and (b) the demonstration and use of improved crop varieties, integrated pest and nutrition management, as well as appropriate agronomic practices (c) diversification of agriculture with introduction of fruit crops and vegetables. Public-private partnership in agricultural service delivery will be encouraged. This sub-component will also support adaptive research on broad thematic priority areas such as extent of water use, presently, substitution of crops for saving of water combining high income, integrated farming system strategy, suitable for the project locations. The adaptive research program will be built on the technologies that have been already developed by the state agriculture universities, the Central Arid Zone Research Institute, the International Crop Research Institute for Semi-Arid Tropic, the International Centre for Agriculture Research in the Dry Areas, and other partners through the Global Program on Climate Change, Agriculture and Food Security. The project will also support strengthening of studio and printing facilities of Agriculture department for ICT activities. The components for market information would be as under:-

B1: Setting up Farmer Common Service Centres

This sub-component aims to provide alternative marketing channels in addition to the existing regulated wholesale (APMC) markets and link farmers to the alternative markets for capitalizing on the emerging agricultural marketing opportunities. The focus of this activity is on organizing farmers into commodity groups and larger producer organizations (POs); developing their capacity and skills for marketing by accessing wider markets; and investment support to the POs for the establishment of farmer common service centres (FCSCs) as is being done in the World Bank funded Maharashtra Agricultural Competitiveness Project (MACP). The FCSC is a small scale aggregation place owned, managed and operated by the producer organization. The project will finance ‘productive’ demand-driven investments on a grant basis to the producer organizations for establishing these common service centres.

The mobilization of producer groups and producer organizations, and establishment of common service centres will be carried out by suitably qualified service providers since the required skills are not available in the Government Departments. Producer organizations will be enable to undertake various activities such as bulk purchases of inputs for delivery to individual members, aggregation of agricultural produce, grading, packing, quality control and marketing. The benefits to the farmer members of producer organizations are expected to be higher farmer prices through a combination of larger critical mass of saleable produce thereby providing economies of scale, savings in transaction costs and strengthened negotiation positions, coupled with the value addition achieved through primary grading and packing.

Objectives of farmer common service centres (FCSCs): The Main Objective is Produce Aggregation & Sale through Producer Association. Similarly,

- Commercialise Farm Produce.
- Enhance bargaining power of the Farmer.
- Enable farmers to fetch premium price for their produce.
- Improve farmers’ access to alternative markets.

This could be achieved by:

a. Value addition (primary processing) of the produce,
Project Components

b. Provision of Warehouse Receipts to store produce & avoid glut season low price of the farm produce.
c. Selling produce directly to consumers through Direct Market license holder and through private markets.
d. Selling produce using e - marketing platforms.

Concept of farmer common service centres (FCSCs)

- A PG will be formed by bringing 12 to 19 active farmers together as voluntary group.
- 15-20 PGs will be formed in a village or a group of villages within the radius of 3-5 Kms.
- Federating 15 to 20 PGs into Producers Organization (POs) which will be registered under the Producer Companies Act.
- PCs will establish FCSCs as small scale commonly owned commercially viable business transaction workplace.

Framework

- FCSC will be established at the village with legal status,
- Member farmers themselves will manage FCSC.
- FCSCs will be eligible for financial grant under RACP project for creating basic infrastructure.
- Approximate minimum 10,000 sq. ft. land would be required.
- Land should be either purchased by contribution / gifted or it may be taken on lease/rent.
- Document like sale deed, gift deed, and lease deed will be registered and kept on record for any future reference.

Activities

- To provide basic infrastructure for post-harvest handling like – cleaning, grading & packing of food grains, fruits & vegetables in more hygienic conditions.
- Input purchase- Bulk collective purchase of inputs like seeds, fertilizers, manures, pesticides, cattle feed etc. for the member farmers.
- Output Marketing- Aggregation, cleaning, grading, packing and marketing of agriculture produce collectively.
- Collective practice through FCSCs will bring advantages like saving of charges like commission agents, market fees, hamal fee, etc. Getting linked to the value chain of different commodities reducing substantially the transaction cost.

Member Selection Criteria

- Willingness to become a member.
- Active participation in all functions and activities.
- Voluntary contributed his/her equity to the Producer Organizations (PO).
- Ready to bring his/her produce to the FCSC for sale.
- Ready to purchase his/her farm inputs through the FCSC.
- Ready to produce and prepare his/her produce for marketing as per directions of FCSC.
- Voluntary contribution of his/her share to the PO as upfront payment for business development plan of FCSC as needed.
- Voluntary contribute of his/her share to the PO towards the reserves of FCSC as needed.
FCSC (Food Grain)

Targets
Establishment of two types of common service centres is planned. One group of common service centres (about 100) is planned to be established for cereal, pulse and oilseed producing areas, and will provide cleaning, grading, aggregating and packing facilities for cereal, pulse and oilseed producers. FCSCs will be linked to the RSWC godowns identified for providing Warehouse Receipt Financing and E-trading services. FCSCs will also have the options to avail the warehouse receipt from the selected & accredited APMC godowns in vicinity of the MSWC godowns.

Illustrative list of Stage I Infrastructure Investment Items
- Improvement of temporary storage and drying.
- MT per hr. grain cleaning, grading, and packing machinery with shed
- Additional need based Agricultural Equipment's

Illustrative list of Stage II Infrastructure Investment Items
- Computer with internet connectivity for MII
- Display Board with Accessories
- Auction Hall – 500 sq. ft.
- Godown - 150 Tones Capacity
- Drying Yard
- Input Suppliers Shops -10, each of 150 sq. ft.
- Toilets
- Drinking water & Electricity

Actual infrastructure to be developed will be need based and on participative consultation process

Second group of another about 100 common service centres are planned to be established in high value vegetable, fruit, spice, medicinal and aromatic crop producing areas, and will provide cleaning, grading, and packing services for the high value crops.

Illustrative list of Stage I Infrastructure Investment Items
- Small common pack house for fruits and vegetables, of 300 sq. ft. with asbestos cement sheet roof, flooring, ventilation, toilet.
- Plastic crates (20 kg capacity) 1000 crates
- Grading and packing tables for fruits and vegetables
- Need based Agricultural Equipment's

Illustrative list of Stage II Infrastructure Investment Items
- Computer with internet connectivity for MII
- Display Board with Accessories
- Auction Hall of 500 sq.ft
- Pack house for washing, grading, packing of fruits and vegetables (500 sq.ft) with packing table
- Fax machine with furniture
- 5 M.T. Cold Storage
Project Components

- Drinking water & Electricity
- Toilets

Actual infrastructure to be developed will be need based and on participative consultation process

B2: Setting up Centers of Excellence:

The objective of this sub component is to disseminate full-fledged technology for farmers for getting benefit out of it. It will help to develop the recipe and value addition of the commodities as well as training of farmers and entrepreneurs for commercialization and creation of suitable environment. The Centre of Excellences focusing prominent commodity of the area will be established under the Rajasthan Agricultural Competitiveness Project (RACP) in collaboration with private agri-business companies under Public Private Partnership (PPP) approach for market led technology transfer and production processes.

Rajasthan is having tremendous opportunities in the field of agriculture and horticulture production provided appropriate technology can be transferred to the farmers and adopted in right way. Although adverse conditions are prevailing in the state but Rajasthan is largest producer of mustard (oilseed crop) pearl millet (bajra), and three spices: coriander, cumin, and fenugreek; cluster beans and isabgol; and it are the second largest producer of maize in India. Rajasthan has the second largest herd of livestock amongst Indian states contributing about 10 percent of the country's milk and 30 percent of mutton production.

The state also produces wheat and coarse cereals, rapeseed, gram, and soybean. Agriculture and livestock production take place across ten distinct agro-ecological zones, and often in extreme agro-climatic conditions. In much of the state only one rainfed crop can be grown during the kharif (or monsoon) season which, too, is associated with high climate-related risk. Ongoing climate variability and climate changes result in decreasing surface and ground water availability, flash floods, degradation of soil resources, decrease in crop yields, greater vulnerability to pest outbreaks, and declines in forest and pastureland ecosystems, thus rendering agricultural and herding communities extremely vulnerable to weather related losses of life, livelihood, and food security. Given this situation, farmers will need to adapt further and make agriculture practices still more resilient in the light of ever harsher and changing agro-ecological conditions.

In addition to harsh and erratic agro-climatic conditions, agriculture production is constrained by farmers having limited access to inputs (land, seeds, fertilizers and water), technology, markets and farm credit. This has resulted in a predominance of low productivity, risk-minimizing and subsistence-oriented farming systems (often integrating crop and livestock production) capable of resilience (within limits) against droughts as well as able to produce a marketable surplus in years of good monsoon rainfall.

While challenges in making the semi-arid dessert bloom are many, there are also significant opportunities associated with agriculture in Rajasthan. These include: (1) a promising potential for diversification into higher value, less water consuming horticulture, floriculture, spice and medicinal plant production across a variety of agro-ecological zones; (2) scope for livestock development focusing on improved breeding, animal health, nutrition and access to markets; (3) the availability of a range of tested on-farm water management technologies and agronomic practices that can be rolled-out to the farming community; (4) a policy framework that, while not necessarily perfect, is increasingly conducive towards private sector-led, sustainable agriculture, including recently revised state policies on agriculture, livestock and agribusiness development as well as on water resources management; and (5) experience in establishing and managing public private sector partnerships in agriculture (for instance, in the seed sector) that can be expanded towards a broader application.

Similarly Rajasthan has excellent potential for horticulture development, in spite of several biophysical as well as development constraints. The endeavors’ over the past decade made for planned and systematic development of horticultural in the state have now been visualizing in the crops and this sector has established its credibility for more income per unit area, employment
generation and improving nutritional status of the people of state. This is a beginning and the huge untapped potentials are yet to be utilized for the betterment of state.

**Objective of the Centre of Excellence:**

The aim of this centre focused with the following objectives:

1. Establishing intensive crop cultivation sites by demonstrating the latest agricultural technologies.
2. To demonstrate tested on-farm water management technologies production technologies.
3. To sensitize farmers and to build their capability for empowerment and adoption of the technology
4. To achieve optimum productivity and profitability per unit area

**Justification of the Project:**

- Climatically required for above mentioned crop suits to project area.
- New Technologies especially in high density planting, mechanization and micro irrigation technologies and there is urgent need for transfer of technology quickly for the benefit of growers/farmers by way of demonstration of having good nurseries, planting material, orchard and post-harvest management and emphasis on water management technology.
- There is hardly any integrated unit where all the required present day technologies are being demonstrated.
- The present project incorporated all the inputs right from planting to post harvest of fruits for effective demonstration of the technologies to tap potential productivity.

**B3: Use of Information and Communication Technology (ICT) for Farmer Advisory Services:**

Extension is typically seen as a service that responds to the needs of farmers for agro technologies they can adopt to improve their productivity, income and welfare, and to manage the natural resources on which they depend in a sustainable way. Extension brings information and new technologies to farming communities, allowing them to improve their production, income and standard of living. The concept of Training and Visit (T&V) extension was developed in the early 70s, and implemented in India during 1974 and adopted in many Asian countries in 1980s. Many development scholars and extension practitioners commented on the weakness of the T&V design and implementation and the model disappeared within 25 years of its inception in many countries including India. Some of the extension performance issues highlighted, which are i) the cost of reaching large, ii) geographically dispersed and remote smallholder farmers, iii) high transport costs, iv) weak accountability to clients and v) financial unsustainability. With large and diversified clientele, only a small fraction of framers can be served directly (face-to-face) by extension, and agents tend to focus on the larger, better resourced and more innovative farmers. Limited outreach to smallholder clientele reduces the benefits and impact of extension.

The public extension system like T&V was also criticized due to its top-down approach, which have been supply-driven, technically weak, patronizing, catering only to large farmers and providing insufficient coverage of and contacts with farmers. The public extension services were ineffective in reaching farmers and farm communities with agricultural information and technologies needed to ensure food security and sustainable development. Despite the limitations, farmers have managed to obtain information from other sources. It is obvious from the results received till now, that there is need for agricultural information to suit the needs of farm communities - thus necessitating improvement in ways and means to provide the extension support that meets the demands of farm communities.

Action research on the development of a sustainable, workable and replicable ICT based agricultural extension model accomplishing the information needs of small farmers in time was felt essential in a developing country like India. ICT based agricultural extension model of technology support for sustainable farming named as “e-Velanmai” (‘Velanmai’ means ‘agriculture’ in Tamil language;
"electronic-agriculture") was conceived to achieve the goals of agricultural development and improve the standard of living of the farmers in India. This paper describes the action research process and effects of the innovative and sustainable ICT based extension approach implemented in Tamil Nadu and outline its applicability of adoption in developing countries. The overall objective of the action research project, 'e-agriculture' is to provide quality, timely, farm-specific scientific advice with the support of three components namely ICT tools, agricultural scientists and Field Coordinators (FC) to the needed farmers at their farm gate. This is an ICT based demand-driven participatory extension system for providing timely agro-advisory services by the State Agricultural University scientists and extension workers to the farmers using ICT tools (internet, computer, digital camera, mobile phone, etc.) on need and/or regular basis. Five essential components of this technology transfer model are:

- Farmers who are enrolled as members of e-Velanmai scheme
- Expert team (s) of scientists formed at the State Agricultural University
- Field Coordinators/Research Fellows (extension services) for training and capacity building of farmers
- ICT tools to link farmers and experts
- Information about agricultural and natural resource management problems (data) collected from farmers for advice

Other need-based components include the technical message delivered by the experts to solve agricultural problems faced by the farmers, and the follow up actions on the advice adopted by the farmers.

**Methodology**

An action research project is to be initiated to test-verify and validate the ICT based agricultural extension model called 'e-velanmai' (e-agriculture). It is aimed at addressing the problems of farmers in agriculture through ICT tool based dissemination of agricultural technologies from scientists of State Agricultural Universities (SAUs) either directly to the needed farmers or through Field Coordinators (FC) sourced from the project. The project would be supported across the state in selected project areas under the project. The description of the extension model is presented as follows:

**Components of e-agriculture**

There were six vital components in the project as given below:

- Farmers - the enrolled members in the 'e-agriculture' project.
- Multidisciplinary expert team of scientists formed at State Agricultural Universities (SAUs) (at district level/Project Area level)
- Field Coordinators (FC) to develop the capacity of farmers in handling ICT tools and to facilitate the technology transfer.
- ICT tools like computer, internet, mobile phone and camera to link farmers, FC and experts
- Information about the agricultural problems (images/data) collected from farmers for advice
- The technical message delivered by the experts to solve problems faced by the farmers and follow-up actions on the advices adopted by the farmers.

This technology transfer model typically follows the development communication model proposed by which included the elements of communication namely Source (Data from farmers for consultation with experts), Message (Technical advice), Channel (ICT tools), Receivers (Farmers), and Effect (Adoption and follow-ups).

To enhance the participation of farmers in scientific farming and to achieve sustainability of the project, paid model of 'e-agriculture' to be introduced in selected areas of RACP.
Deliverables of 'e-agriculture' to the farmers

The project delivered timely and quality technical advices making use of ICT tools within a turnaround time of 1-3 hours to the farmers' problem based queries on the areas such as crop production, protection, management and post-harvest technologies including decision based queries on market intelligence, market price forecast, and weather forecast based management decisions related to agriculture, horticulture, forestry, sericulture, agricultural engineering, and veterinary enterprises. The problem based queries (e.g.: Management of insect pest/disease/nutrient deficiency in crop) were addressed by analyzing the digital images on the crop status sent by the FC to the scientist team set up at the university. The decision based queries (for e.g.: Market price forecast of agricultural commodities over a season/spacing/varieties to be adopted etc.) were answered instantly without a photo document. Other extension services delivered to the farmers under the ‘e-agriculture’ project are detailed as follows:

- Training all he farmers or their wives or adult children (at least one in each farmers' family) on handling ICT tools such as framing digital photographs of the pest symptoms and uploading the same to the scientists for getting technical advice.
- Field diagnostic visits to farmers' field by a multidisciplinary team of scientists to solve complex, serious and endemic problems in agriculture and allied enterprises.
- Organizing technical seminars on vital topics related to agricultural enterprises to farmers in their villages by the scientists team of the project.
- Millions of INR were spent to develop various crop management, production and protection technologies related to agriculture and allied enterprises as suited to the agro climatic zones of Rajasthan by the scientists for the benefit of its farmers. This information is to be disseminated to all the farmers of the entire state by providing the contents on this aspect in Hindi in the project web site for the benefit of the farmers to adopt scientific farming practices.
- Dynamic market price forecast, season-wise price trends and market intelligence of major commodities would also be analyzed seasonally and disseminated to the farmers from Domestic and Export Market Intelligence Cell. This information is also to be uploaded in the web site of the project which provided effective guidance for the farmers to take decisions to market their commodities in the state or elsewhere in the country.
- The website also feeds the block wise and district wise day to day weather status of the state on certain vital parameters such as temperature, RH, wind and rainfall forecast for next four days generated, to the farmers.
- A video film explaining the process of technology transfer, implementation and success stories running to seven minutes in Hindi and Rajasthan is to be uploaded in the web site which also briefs about the scheme activities.

B4: Promoting Adoption and Documentation of Improved Technologies: This sub-component aims to raise productivity of selected field, vegetable, fruit, spice, medicinal and aromatic crops and improve water use efficiency in the project areas by promoting large scale adoption of improved and integrated crop husbandry and natural resource management practices by the farmers. Unlike the present practice of organizing narrowly tailored demonstrations (e.g., only on a new variety or a single package of practice like fertilizer application or weedicide dose) as is normally being done under various ongoing Government of India/Rajasthan schemes like Rashtarya Krishi Vikas Yojna and National Food Security Mission, RACP will support integrated crop management (ICM) demonstrations encompassing the complete package of practices for a particular crop from land preparation to harvesting of the crop [including use of seed of improved high yielding varieties/hybrids, seed treatment, optimum plant population, soil test based application of fertilizers (including use of organic manures, bio-fertilizers and micronutrients), weed control, integrated pest management (including use of bio-pesticides, and bio-rational pesticides), efficient methods of on-farm water management, carrying out all cultural practices at the optimum stage of crop, etc.] in each individual on-farm demonstration. Special attention will be paid to include all high payoff...
interventions and low cost methods for improving on-farm water use efficiency such as alternate furrow irrigation, paired row irrigation, use of crop residues as mulches for reducing evaporation loss, etc. as an integral part of each individual ICM demonstration. Farmer trainings will also be linked and fully integrated with ICM demonstrations, with each demonstration having about four training sessions from preparation of land to the field day organized shortly before harvesting of the crop for showing the actual impact of adopting all integrated crop management practices on crop stand as compared with the farmer practice control to large number of farmers in project villages.

Demonstrations will be conducted on various cereal, pulse, oilseed, vegetable, fruit, spice, medicinal and aromatic crops grown in the area with a clear thrust on popularizing high payoff interventions and improving water use efficiency. Some additional demonstrations will be conducted for promoting resource conservation technologies, and for popularizing climate smart agricultural practices in Rajasthan. The project will also support post-harvest management demonstrations for promoting farm level cleaning, grading, aggregating, packing and value addition to the agriculture and horticulture produce. A broad menu of interventions for agriculture and horticulture has been developed. High pay-off interventions will be selected from this menu depending upon agro-ecological conditions and emerging marketing opportunities in a geographical setting.

In view of the importance of seed in increasing crop productivity and the low seed replacement rates in Rajasthan, special attention will be paid to technology empowerment of the farming community for production of quality seed of high yielding varieties of self-pollinated crops by organizing seed production demonstrations. Support will also be provided for promoting production of hybrid seed of Bajra by the farmers.

The project will also support adaptive trials for testing of promising crop husbandry practices and on-farm water management technologies which are at an advanced stage of development by the State Agricultural Universities in Rajasthan and require on-farm testing, refinement and validation.

In a major deviation from the present approach of assessing demonstrations only in terms of completing the physical targets of organizing demonstrations, the success of demonstration program will be assessed in terms of adoption of the demonstrated technologies by the farmers in the years following the year in which the demonstrations are organized. This will involve following steps:

- Organizing training and sensitization sessions in the villages before sowing of the crop in the year following the year in which demonstration was organized and encouraging them to adopt the technologies which were demonstrated in the previous year
- Providing adoption support in terms of supply of critical inputs like seed on cost sharing basis to the farmers provided they give an undertaking to adopt the package of demonstrated practices.
- Providing training and technical backstopping to the adopter farmers
- Tracking and documentation of adoption of demonstrated technologies by the adopter farmers in terms of their number, area on which adopted and gains in productivity achieved vis-à-vis baseline yield before adoption. The focus will be on promoting adoption of high payoff interventions (and not necessarily the complete package of demonstrated technologies) by large number of farmers

Comparison of gains in productivity achieved in the demonstration plots and by the adopter farmers in the following years. Although the yields of adopter farmers are expected to be lower than the demonstration plots (because of provision of all inputs and intensive technical support), the demonstration program will be regarded as successful if large number of farmers adopt critical technologies over substantial area.

**Activities**

**Soil Testing:**

Analysis of soil samples and issue of soil health cards to the farmers.
On-farm Demonstrations:

Integrated crop management (ICM) demonstrations will be the core of project interventions and the main vehicle for the dissemination of improved technologies to the farmers. The ICM demonstrations will include the complete package of practices for a particular crop from land preparation to harvesting of the crop (including use of seed of improved high yielding varieties/hybrids, seed treatment, soil test based application of fertilizers (including use of organic manures, bio-fertilizers like Azotobacter, Rhizobium, PSB) and micronutrients, weed control, integrated pest management (including use of bio-pesticides, and bio-rational pesticides), efficient methods of on-farm water management, use of mulches, carrying out all cultural practices at the optimum stage of crop, etc.). Special effort will be made to include low cost methods for improving on-farm water use efficiency such as alternate furrow irrigation, paired row irrigation, use of crop residues as mulches for reducing evaporation loss, etc. as an integral part of ICM demonstrations. Majority of the demonstrations will be on the value chain crops with a focus on popularizing high payoff interventions and reducing water footprint of the crop. Demonstrations will also be conducted on other crops which are grown in a cropping sequence with the value chain crop with the objective of improving water use efficiency, diversification to low water requiring, high value and other crops, reducing water footprint, etc. Another set of demonstrations will be on promoting resource conservation technologies, and for popularizing climate smart agricultural practices. These demonstrations will need to be integrated with the on-farm water conservation structures developed under water sub-component of the project.

Field Days:

For dissemination of the improved technologies demonstrated in the ICM demonstrations to large number of farmers, field days will be organized in the villages in which these demonstrations are organized. The field days will be organized near the harvesting stage of the crop so that the farmers are able to see the differences between the prevalent farmer practice and the improved package of practices for a particular crop.

Adoption support:

Quality seed of high yielding crop varieties is a critical input for increasing productivity. It also acts as a catalyst for the adoption of other improved crop husbandry practices. In view of the importance of seed in increasing crop productivity and the low seed replacement rates in the selected micro-clusters, adoption support in terms of 50% cost of seed (for sowing one acre of crop) will be provided to the farmers in the selected villages provided they give an undertaking to adopt the package of practices demonstrated for the value chain crop in the ICM demonstrations organized in that village in the preceding year. This will also help in tacking adoption rates of the demonstrated improved technologies by the farmers. Criteria for selection of farmers for adoption support and other relevant details are provided in the annexure at the end of chapter.

Seed Production:

Special attention will be paid to technology empowerment of the farming community for production of quality seed of high yielding varieties of self-pollinated crops by organizing seed production demonstrations, including grading, packaging and certification.

Post-Harvest Management:

The objective of these demonstrations will be on promoting farm level drying, cleaning, grading and post-harvest management of the harvested produce. It will also include provision of low cost plastic sheets for protection against damage by rain and water.
Adaptive Trials:
These will cover on-farm testing of the promising emerging technologies which are at an advanced stage of development and are ready for on-farm validation and testing. The adaptive trails on the promising technologies relevant to a particular cluster will be conducted by the concerned state agricultural university.

Farmer Training:
These will cover training and capacity building programs for farmers and farm women for adoption of knowledge-based crop husbandry and natural resource management/conservation practices for increasing productivity, enhancing diversification to high value and low water requiring crops/practices for reducing water foot print of agriculture, enhancing farmer incomes and improving rural livelihoods. Training programmes of 2-5 days duration on the technology to be adopted under CACP will be organized for farmers by SAUs/KVKs through facilitation by NGO.

Exposure visits:
Exposure visits for farmers will be organized within the state and outside the state so that the farmers are able to see the successful production, post-harvest handling and marketing innovations developed at different places.

Training of Service Provider Staff and Line Department Staff:
These will cover training programs for staff of the service providers (NGO) and staff of line departments about the project design, implementation arrangements, technical areas of crop production, post-harvest management and other related aspects to be organized by SAUs.

Promoting Green Agriculture
In all the clusters special efforts will be directed in promoting good agriculture practices. Presently with the major focus on green revolution the farmers are increasing the use of chemical fertilizers and pesticides and the issue of soil health has not been addressed properly. In some of the command areas farmers are using fertilizer in excess of recommendation. There is a growing imbalance in the use of fertilizer especially more nitrogen is added neglecting phosphorous and potash. In many areas addition of organic matter vital for sustainable agriculture is neglected. Therefore, effort in the project would be demonstration of technologies that permit high production with limited use of input resources. Effort will be made in capacity building of the farming community in green agriculture. Use of bio control agents would be promoted for control of insect, pest and diseases. Improved composting, vermi composting and use of bio fertilizers would be vigorously promoted. For enriching soil practice of green manuring or use or organics in crop production will be promoted. Recycling of agri waste would help to build soil health. Fertilizer recommendation for the value chain crops in the area will be made on the basis of soil analysis. The soil analysis will also help in identifying constraints to increase production and the strategy is to ensure soil health improvement for sustainability agriculture production.

Resource conservation technologies will be adopted on a large scale for not only increasing production, productivity, profitability and saving of natural resources but also for ensuring sustainability over the long period. These will include raised bed planting, use of drip and sprinkler, use of mulch for reducing evaporating losses, incorporation of agriculture residues in soil, zero-tillage wherever applicable, land leveling, etc.

Integrated Pest Management (IPM)
The misuse of pesticides in agriculture has resulted in several problems like residues in crop produce, resurgence of treated insects, development of resistance in target insects, hazards to the non-target insect pests and environmental contamination. The increasing demand of qualitative food products across the globe sensitized Scientists to think over on existing chemical based control strategies and put forth economically viable, ecologically sound and sociologically acceptable technologies. Integrated Pest Management is the best alternative to all problems so far created by the synthetic chemicals. It provides the decision support system to the farmers for effective management of
obnoxious insect pest, however, it requires a sound planning before cultivation. IPM is an intelligent selection and use of control tactics either singly or in combination to reduce the pesticide load in the agro ecosystem. The application of the chemicals is the last option when other techniques are insufficient in the control of increasing pest population.

IPM has been effectively demonstrated in many crop ecosystem especially cotton, cereals, pulse, vegetable crops and fruit crops. The following approaches will be at the core of IPM strategy:

1. Alteration in the sowing time- It helps the host plant to escape the infestation of insect pest or avoid the economic damage.
2. Clean cultivation- Weed free cultivation helps in the removal alternate hosts of the insect pests.
3. Selection of crop varieties- High yielding varieties is usually susceptible to many insect pests, therefore selection of either resistant or moderate resistant varieties help in the over dependency on pesticides. Most of the new varieties developed have in built resistance to several diseases and insect pests and will be of preference in selection.
4. Use of Bio agents and Bio pesticides- The use of bio agents and bio pesticides in the early stage of population build-up of insect pest in crop ecosystem. The multiplication of many bio agents and bio pesticides is taken up in the Agricultural Universities as well as in the laboratories of the State Agricultural department. Production of Trichogrammatids, Chrysopids, Trichoderma and NPV are taken up in large scale and also well supported by the State policies. An early demand may strengthen the Bio based Pest management. The supply of these live materials to the farmers in quantity as well as quality timely is a serious concern for the success of technology.
5. Need based application of pesticides- The use of pesticide should take as last remedy and discouraged as schedule treatment. The use of threshold values, monitoring and forecasting helps a lot in the management of over and misuse of insecticides. The recommendation of less quantity base insecticides, environmentally safe products like Insect growth regulators will help in the minimization of pesticides.
6. Nutrients management- Balance application of fertilizer and use of organic manure also help to the crop ecosystem to defend the losses caused by noxious organisms.

The selection of effective control tactics and application of crop based pest management schedules will definitely reduce the pesticide load in the agro ecosystem and the losses of organisms. It may help in the reduction of pesticide load to the tune of two third in most of the crops while three fourth in some of the crops.

Therefore, IPM will be promoted as a strategy for controlling pest population. IPM will include different aspects like host plant resistance, regulatory measures, cultural practices, biological control, botanical pesticides, chemical control and other measures.

**Policy support**

**Awareness creation:** Kiosks, Print and e-media, Manuals, pamphlets, brochure, SMS over Mobile phones and Farmers fairs/group discussions

**Input management:** Seeds, Fertilizers, Cultural practices - Sowing schedule/time, seed rate, inter/mono/mixed cropping, cropping sequence, mulching, irrigation, weeding, etc. and Pesticides - Bio-control agents, botanicals, chemicals

**Capacity building:** Training of Agricultural Extension Officers, Sensitization of agri-input dealers, Training of women, Technology demonstrations
Horticulture

Rajasthan offers comparative advantage in respect of arid horticulture for reducing footprint of water in agriculture and increasing farmers’ income. Diversification to horticulture will lead to higher income to farmers with limited input resources. Adoption of drip will lead to besides increase in production, saving of irrigation water use. In most of the agro climatic regions demonstrations will be laid on growing of vegetables, fruit crops and establishment of poly houses and shade nets depending upon comparative advantage particular agro climatic region offers. Adoption of horticulture by way of vegetables, fruit crops and floriculture will lead to enhanced income and generation of additional employment. In command areas special emphasis will be on shifting from high water requiring crops to horticulture crops that could be grown on sprinkler and drip for saving in water. Along with promotion of horticulture, Post-harvest management and processing and value addition would also be promoted so as to further increase income of the farming community. Arid horticulture specially Pomegranate and Mandarin, poly house cultivation of vegetables and flowers, use of drip, low tunnel raised bed cultivation will be taken up on large scale which will provide increased income, higher rural employment with less use of water. Further link to markets after primary and secondary processing will lead to substantial enhancement in farmer income.

Protected cultivation and micro irrigation can break the land holding barrier which has been the bane of the Rajasthan Agriculture. Given the fact the Rajasthan is a land of small and marginal farmers and that it will not be possible to increase per capita farm size, the only option is to increase productive capacities manifold to make income rise at a much greater pace. This is where the horticulture sector brings in its unique competitive advantage with shade nets, poly house and micro irrigation. It is possible for a 300 sq. m plot of land to generate an income of up to Rs.2.00 to 3.00 lakh per annum (an impossibility in a rice-wheat/cotton/ fennel cycle).

1. Setting up Farmer Common Service Centres: This sub-component aims to provide alternative marketing channels in addition to the existing regulated wholesale (APMC) markets and link farmers to the alternative markets for capitalizing on the emerging agricultural marketing opportunities. The focus of this activity is on organizing farmers into commodity groups (CGs) and larger producer organizations (POs); developing their capacity and skills for marketing by accessing wider markets; and investment support to the POs for the establishment of farmer common service centres (FCSCs). Commodity groups (CGs) will be formed by bringing farmers together in the form of voluntary group of about 12 to15 active farmers. 15 to 20 CGs would be federated into Producers organizations (POs). Such Producers organizations (POs) will form Farmer Common Service Centre (FCSC). FCSCs will be functioning on behalf of the member farmers and will strive to undertake various activities. Farmer Common Service Centre (FCSC) will provide village level basic infrastructure for post-harvest handling like cleaning, grading, packing of fruits and vegetables in more hygienic conditions. Farmer Common Service Centre (FCSC) may involve in marketing and supply of Inputs such as seeds, fertilizers, manures, pesticides, cattle feed to the members & farmers as well as Aggregation of produce, its cleaning, grading and marketing of aggregated graded produce.

The FCSC is a small scale aggregation place owned, managed and operated by the producer organization FCSC will be located at the village level and will have a legal status, owned and managed by PO registered as a society under Societies Registration Act of 1860 or under Producer Companies Act of 1956. Representatives of the member farmers will manage FCSC. FCSCs will be eligible for financial grant under the project to provide some basic facilities to the farmers within the vicinity of the FCSC.
The project will finance ‘productive’ demand-driven investments on a grant basis to the producer organizations for establishing these common service centres. The benefits to the farmer members of producer organizations are expected to be higher farmer prices through a combination of larger critical mass of saleable produce thereby providing economies of scale, savings in transaction costs and strengthened negotiation positions, coupled with the value addition achieved through primary grading and packing.

Establishment of 100 FCSC are planned to be established in high value vegetable, fruit, flower, spice, medicinal and aromatic crop producing areas.

The mobilization of Commodity groups (CGs) and producer organizations (POs), and establishment of common service centres will be carried out by suitably qualified service providers since the required skills are not available in the Government Departments.

2. Setting up Centres of Excellence:

Horticulture has invariably improved the economic status of farmers. The earlier seasonal availability of fruits and vegetables has now extended to all the year round, increasing the per capital consumption of fruits and vegetables. It has also played a significant role in women empowerment, providing employment opportunities through mushroom cultivation, floriculture, processing, nursery raising, vegetable seed production etc. The national goal of achieving 4% growth in agriculture can be achieved through the major contribution in growth from horticulture.

Rajasthan with its diverse agro-climatic conditions, favours growing of a large number of horticulture crops like fruits, vegetables, root & tuber crops, spices, flowers and medicinal and aromatic plants. The agro-climatic diversity in the state is immensely suitable for fruit crops like aonla, kinnow, guava, oranges, limes, papaya; spices like coriander, cumin, fennel, turmeric and chilly, a variety of root and tubers and a whole range of vegetables. The State thus enjoys a natural comparative advantage for horticulture with possibilities for growing a diversified basket of fruits, vegetables, spices, tubers and flowers; whose potential has not been fully exploited.

Setting up Centre of Excellences with commodity focus and in collaboration with private agri-business companies under PPP approach for market led technology transfer and production processes has been envisaged under the sub-component. These Centre of Excellence will serve the state in:

Production of quality planting materials of horticulture crops, facilitate timely supply of quality planting materials, of horticulture crops to farmers, promote multiple crops per season per unit area, impart training to farmers/entrepreneurs/staffs, act as a demonstrative farm for farmers.

Based on potential lead commodity of the selected cluster, Centre of Excellences in collaboration with private agri-business companies under PPP approach would be established.

3. Use of Information and Communication Technology (ICT) for Farmer Advisory Services:

The project will support adapting to selected project areas e-Velanmai model of extension/technology transfer developed by Tamil Nadu Agricultural University Coimbatore under the World Bank funded Tamil Nadu Irrigated Agriculture Modernization and Water-Bodies Restoration and Management (TNIAMWARM) Project. This is an ICT based demand-driven participatory extension system for providing timely agro-advisory services by the State Agricultural University scientists and extension workers to the farmers using ICT tools (internet, computer, digital camera, mobile phone, etc.) on need and/or regular basis. Five essential components of this technology transfer model are:

- Farmers who are enrolled as members of e-Velanmai scheme
- Expert team (s) of scientists formed at the State Agricultural University
- Field Coordinators/Research Fellows (extension services) for training and capacity building of farmers
- ICT tools to link farmers and experts
• Information about agricultural and natural resource management problems (data) collected from farmers for advice

Other need-based components include the technical message delivered by the experts to solve agricultural problems faced by the farmers, and the follow up actions on the advice adopted by the farmers.

4. Promoting Adoption and Documentation of Improved Technologies:

This sub-component aims to raise productivity of selected vegetable, fruit, spice, flower, medicinal and aromatic crops and improve water use efficiency in the project areas by promoting large scale adoption of improved and integrated crop husbandry and natural resource management practices by the farmers. Special attention will be paid to include all high payoff interventions and low cost methods for improving on-farm water use efficiency such as alternate furrow irrigation, paired row irrigation, use of crop residues as mulches for reducing evaporation loss, etc. as an integral part of each individual ICM demonstration. Farmer trainings will also be linked and fully integrated with ICM demonstrations, with each demonstration having about four training sessions from preparation of land to the field day organized shortly before harvesting of the crop for showing the actual impact of adopting all integrated crop management practices on crop stand as compared with the farmer practice control to large number of farmers in project villages. On-farm integrated crop management (ICM) demonstrations will be the core project intervention under this sub-component and shall be the main vehicle for the dissemination of improved technologies among the farmers.

(A) Integrated Crop Management Demonstration (ICM):

RACP will support integrated crop management (ICM) demonstrations encompassing the complete package of practices for a for a particular Horticultural crop from land preparation to harvesting of the crop (including use of seed of improved high yielding varieties/hybrids, seed treatment, soil test based application of fertilizers (including use of organic manures, bio-fertilizers like Azotobacter, Rhizobium, phosphorus solubilizing bacterial) and micronutrients, weed control, integrated pest management (including use of bio-pesticide), efficient methods of on-farm water management, Micro Irrigation, Protected Horticulture, Solar Pumps etc carrying out all cultural practices at the optimum stage of crop in each individual on-farm demonstration. Area of the demonstration will be 0.4 to 5.0 ha for horticultural crops, micro irrigation systems, low tunnels and mulches, whereas area of demonstration for protected cultivation like green houses and shade houses will be 500 to 4000 sq. meter as per the indication given in the CACP.

(i) Integrated Crop Management Demonstration (ICM) on Vegetables, Flowers, Spices and Medicinal and Aromatic crops

Demonstrations will be laid out on Vegetables, Flowers, Spices and Medicinal and Aromatic crops as selected for the cluster based on CACP. The entire cost of demonstration will be borne by the project. Some demonstrations will also be laid out on introducing new technology in prevalent Horticultural crops grown in the cluster covering vegetables flowers, Spices and Medicinal /Aromatic Crops.

(ii) Integrated Crop Management Demonstration (ICM) on Fruits crops, Jojoba, Olive and Date palm.

Demonstrations will be laid out on High Density Planting of fruit crops. Quality seed and planting material of high yielding horticultural crops/quality saplings for fruit crop is a critical input for increasing productivity. Certain new crops such as Jojoba, Olive and Date palm would be introduced. Quality planting material will be procured either from University or from a registered reputed nursery and companies for different crops. Project support will be 80% for general and 90% for small and marginal farmers in demonstration. For Date palm demonstrations project support will be 90% for all the farmers irrespective of their category. Demonstrations would be laid out on High density plantation and Plantation at Normal spacing as per CACP.
(iii) On Farm Demonstration on Micro Irrigation

Water is one of the most critical inputs for agriculture. The availability of adequate quantity of water is one of the key factors for achieving higher productivity in agriculture. However, the poor efficiency of conventional irrigation systems has not only reduced the anticipated outcomes of investments towards water resource developments, but has also resulted in environmental problems like water logging and salinity, thereby adversely affecting crop yields. Micro Irrigation demonstrations will be laid out under close supervision of DPMU. Farmers will be given proper training on micro-irrigation systems before demonstration on their field. Micro Irrigation demonstrations will be laid out on water harvesting structures, wells, Tube wells and water channels as per the water theme of cluster and CACP report.

For Micro Irrigation Systems Cost of optional/supporting items like pump sets, sand filters, hydrocyclone filters and fertilizer tank/injector pumps/ ventury /atomization/ trenching will also be supported through the project funds as per the need of the cluster and funds will be provided for these supporting systems from the project. Project support will be 80% for general and 90% for small and marginal farmers on actual cost of micro irrigation system (Except Drip irrigation) up to the maximum limit of 5 ha per farmer (As per the CACP) for promoting micro irrigation systems in the project area. In case of Drip irrigation system project will provide 90% support irrespective of farmer category.

(iv) On Farm Protected Horticulture Demonstration:

The project will support for 50-100 low cost all weather poly-houses, Plastic mulches, Plastic low tunnels, shade net etc. per the need of the cluster. Size of green houses and shade houses demonstration will vary from 500 to 4000 sq. meter (As per the CACP) Low cost poly-houses will be promoted by laying demonstrations on farmers field. The cost of planting material in the above structures would be admissible from the project funds. For supply of vegetable saplings group activity will be promoted.

Plastic Low Tunnels –

Low tunnels are very useful to grow vegetables out of season. can bring vegetable produce early in the market and fetch economic returns.

Plastic Mulches –

For improving on-farm water use efficiency at low cost plastic mulches will be used to save water losses from soil and to control weed growth. This technology is very useful to grow vegetable crop along with drip irrigation for quality vegetable production.

(v) On Farm Demonstration on Solar Energy:

Solar energy is very important for value added Horticulture development at very low cost. It is eco-friendly and economically viable technology. In Horticulture Solar energy can be used for drying of seed spices, flower petals, vegetables, fruits and medicinal aromatic crops. This technology helps in maintaining natural texture and flavour of Horticultural produce and to fetch better market prices. Solar pump sets are also very useful for irrigating Horticultural and Agricultural crops through micro irrigation systems. Solar pump sets of 2200 and 3000WP are good enough to irrigate crops with micro irrigation system.

(B) Field Days:

For dissemination of the improved technologies demonstrated in the ICM demonstrations on horticulture crops to large number of farmers, field days will be organized in the villages in which these fruit and vegetable crops demonstrations have been organized. The field days will be organized near the harvesting stage of the vegetable crops, so that the growers are able to see the differences
between the prevalent farmer practice and the improved package of practices demonstrated for a particular crop.

- Steps would be taken to ensure technology back stopping by line departments like agriculture, and horticulture.
- Steps would be taken to ensure that large number of farmers attend the field day.
- On the field day the farmers should be shown the control and demonstration plots and encouraged to discuss the likely benefits from the demonstrated technologies.
- A training session should be organized by the project staff to educate the farmers about what has been done in the demonstration plot which is different from the practices normally followed by them; when was it done, how and why; what are the likely benefits; etc.
- Relevant brochures and hand-outs should also be distributed to the farmers on the field day.
- Special attention should be given to educate the farmers about the critical inputs, operations and practices which they should follow to obtain highest productivity levels.
- In addition to short lectures covering specific aspects, farmers should give free time to ask questions so that it is more of an interactive, question and answer session rather than a lecture by an expert.

(C) Post-Harvest Management:

The objective of these demonstrations will be on promoting scientific harvesting, farm level washing, cleaning, grading, packing, transportation, curing, ripening and storage. Post-harvest management of the harvested vegetable/fruit crop produce includes adding value to the produce, increasing profitability and reducing losses. In the clusters having horticulture potential, it is essential to create a network of infrastructural facilities for storage of horticulture produce, transportation, marketing, packaging, grading and export. Individual farmers and registered farmer organizations (MTA’s) will be eligible for assistance. Project will provide 75% assistance for Post-Harvest Management as per CACP report of the particular cluster.

(D) Training of Vegetable/fruit crop Growers:

These will cover training and capacity building programs for farmers and farm women for adoption of knowledge-based crop husbandry and natural resource management/conservation practices for increasing productivity, enhancing diversification to high value and low water requiring crops/practices for reducing water footprint of agriculture, enhancing farmer incomes and improving rural livelihoods. Detailed guidelines for organizing farmer trainings would be as developed for agriculture.

(E) Exposure visits:

Exposure visits for vegetable/fruit/protected cultivation growers will be organized within the state and outside the state so that they are able to see the successful production, post-harvest handling and marketing innovations developed at different places.

(F) Training of NGO/Service Provider and Horticulture Department Staff:

These will cover training programs for staff of the service providers and Horticulture officers involved in the project about the project design, implementation arrangements, technical areas of vegetable and fruit crop production, protected cultivation of vegetables and flowers, post-harvest management and related aspects. Detailed guidelines for organizing these trainings would be as for agriculture.
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Sub Component 1C: Livestock strengthening and management

The objective of this sub-component is to demonstrate how livestock in particular small ruminant productivity adopting climate smart practices and incomes from goat production can be significantly enhanced. Goat Produce (milk & meat) will form the core of a small ruminant livestock value chain which aims to support a potentially significant source of diversified income for small holder farmers operating in difficult climatic conditions. The project will support (a) improving market access and value addition; (b) improving productivity adopting climate smart practices focused on breeding, animal health and feeding and other husbandry practices such as stall feeding, better use of crop residues; improving grazing land and silvipasture on private and common property; and (c) capacity building supporting farmer training Animal Husbandry Department (AHD) staff to backstop delivery of improved technical services and farmer advisory. Small local support units will be built to support farmer training and access to services. Capacity building activities will support livestock broadly not only goats. A feasibility study will assess need for additional AHD support for feed analysis, disease diagnosis and vaccine production.

To improve market and value addition project will support (a) formation of farmer producer groups that would enable the producer to access diversified markets, better access to inputs and services on a gender equitable basis and access to market information; and (b) establishment of small ruminant haats in the selected clusters, where improvement in the basic infrastructure would be taken up. The selection criteria for haats includes, among others: (a) villages should be under the proposed cluster; (b) at least one weekly/quarterly market is organized in the haat; and (c) village Panchayat should have land for construction and willing to take up maintenance. Although the infrastructure that would be needed in the haats will emerge from the market needs assessment through participative consultation, illustrative facilities that would be provided in the haat include (a) covered shed (b) weighing platforms (c) toilets and (d) hand pumps for safe drinking water.

Productivity enhancement will focus on (a) breed improvement through supply of improved adapted bucks; and advisory services to ensure breeding cycle coincides with market demand, climatic conditions/ resources availability, (b) improved feeding through advisory support to improve nutrition and better use local resources; improving availability through improved & expanded fodder and silvipasture development on both private and public owned lands, better integration of crops with livestock through simple storage, production and processing of crop residues to include, feed blocks, chaffing and fodder banks; (c) animal health services that are adequate, targeted and timely provided largely through animal health camps supported by the state veterinarians via mobile vans; (d) animal husbandry and management advisory support to encourage housing and manger/stall feeding to improve feed utilization, reduce disease exposure and promote hygienic practices.

Capacity building encompasses (a) farmer training and ongoing skills and knowledge development and exposure visits to see successful goat value chain; (b) training of Animal Husbandry Department to backstop delivery of technical services, advice and provide project M&E; (c) providing and c) building and equipping small local support units to serve a central role for both the market access and productivity enhancement components. This latter facility will also support agriculture activities within the cluster and beyond RACP will backstop other livestock activities.

A feasibility study will be undertaken exploring options for enhancing the AHD states vaccine production facility, the soil and feed testing lab and disease diagnostics facility, all of which are located in Jaipur. A decision would be taken to take up these activities during the projects midterm review based on the feasibility study.

Starting in Mokhampura, Jaipur, the livestock component of RACP will aim to demonstrate in a number of clusters how goat productivity and incomes from goat production can be significantly enhanced. This will be achieved by 1) improving market access and value addition and 2) improving productivity through breeding, feeding, animal health, and 3) capacity building supporting farmer advisory and training of the farmers, training of existing AHD and new NGO staff and establishment of small local support units (called Regional Technology Centers). In addition to these cluster focused components, fourthly 4) a cross – cutting component is proposed which variously cuts across clusters
and builds not only the capacity to deliver the project, but has the potential to improve livestock services delivery in the state. Further details on these components are detailed below.

**Market access and value addition**: a) formation of farmer producer groups to support market access & value addition, access to inputs and services on a gender equitable basis and b) access to market information and establishment of small ruminant haats which will be self-sustained based on commission charged.

**Productivity enhancement will focus on** a) breed improvement through supply of improved bucks; castration of the marketable surplus to increase average daily gain (productivity); and advisory to ensure breeding cycle coincides with market demand and resources availability, b) improved feeding through advisory support to improve nutrition and better use local resources; improving availability through improved & expanded fodder and silvipasture development on both farmer owned and common property lands, and simple storage, production and processing to include fodder banks, feed blocks and chaffing; c) animal health services that are adequate, targeted and timely provided largely through animal health camps supported by the AHD via mobile vans and Rural Technology Centres ; d) husbandry and management advisory support to encourage housing and manger/stall feeding to improve feed utilization, reduce disease exposure and promote hygienic practices. The project will also provide pregnant goats to a few (60-100) widows in each cluster who are the most vulnerable of the poor.

**Capacity building encompasses** a) farmer training and ongoing skills and knowledge development and exposure visits to see successful goat meat value chain working elsewhere in the state, b) training of workers engaged by the NGO/DPM and AHD staff to deliver technical services and advice and provide project M&E c) building and equipping 3-4 small local support unit (called Regional Technology Centers) per cluster owned by the AHD and staffed by a livestock assistant and 1 veterinarian for every 4 RTCs to be hired by the NGO. Each RTC will cover 8-10 villages (200-250 farmers/ and 3000-4000 goats as well as other livestock) and will serve a central role for both the market access and productivity enhancement components. The RTC facility will also support agriculture activities within the cluster and beyond RACP will backstop other livestock activities such as artificial insemination of cattle/buffalo.

**Cross-cutting** In addition to PIU and District Level Cluster Committee under cross cutting, services from university for training will be provided. A feasibility study will be undertaken related to other possible cross-cutting support including enhancing the states vaccine development facility, the soil and feed testing lab and disease diagnostics facility, all of which are located in Jaipur. A decision would be taken to take up these activities during the projects MTR.

**Component 2: Markets and Value Chains**

Promotion of processing, value addition and marketing is essential for bringing higher economic returns to the farming community. The major challenges are supply chain infrastructure and institutional gaps, inadequate link between production and processing, seasonability of operations, low capacity utilization and lack of product development and innovation. Federating farmers in to producer organizations and forging of a healthy farmer-industry partnership can ensure assured market at pre-determined prices, increased investment in technology and inputs, increased productivity and returns to the farmers.

Therefore, for bringing higher economic benefits and insulating farmers from distress sale, RACP design includes federating farmers initially into farmer producer groups and finally into farmer producer organization (FPO). The FPO will be work for input management, technology transfer, cleaning, grading, packaging and marketing of their produce.

**Sub Component 2A: Agri-Business Promotion Facility**

ABPF under the Project envisages improvement of the existing market infrastructure and help in development of policies and development of value chain. Agribusiness activities will be related to agriculture and allied production, per se, creating backward linkages, e.g. providing quality inputs, and forward linkages, e.g. pulse/seed/spices handling unit to clean, grade and pack. ABPF will
work in close association with PMU of the Project.

The competitiveness of small-holder farmers and agribusinesses will be promoted by facilitating the development and establishment of demand-driven value chains through a participatory approach. An Agri-Business Promotion Facility (ABPF), established under the project, will facilitate (i) the roll out of these participative value chains identification and stakeholder consultation; (ii) promote investments in agribusiness, foster backward and forward linkages in the value chains for agricultural products, facilitate access to finance by agribusiness entrepreneurs, and promote positive policy change; (iii) facilitate the implementation of Rajasthan’s Agribusiness Policy; (iv) mobilize national and state grants and .(iv) Provide agri-business incubation services, with the objective to identify and mobilize emerging agro entrepreneurs.

To promote investments, by agribusiness and other value chain participants, in the selected value chain commodities ABPF would provide pre investment advisory services to processors and producer companies – services covering a range of complex decisions and activities including development of profitable business models, location of plant, reaching internationally accepted quality and sanitary standards, developing a brand, improving workers productivity, finding buyers, approaching financial institutions, etc. This will be done through organizing stakeholder workshops in the clusters with an objective to identifying potentially viable agriculture commodities, setting the longer-term vision and objectives of these commodity value chains, identifying constraints and opportunities that are holding back growth and competitiveness and jointly agreeing with value chain participants and agribusiness on commercially viable solutions that can address these constraints.

To implement Agribusiness Policy of the state, ABPF will facilitate the development of a network of market/producer linkages, provide an ongoing flow of useful information and facilitate a program of cross learning for accelerating economic development of Rajasthan's agricultural sector. It will also facilitate agriculture policy seminars thereby providing a forum for stakeholders in Rajasthan to discuss improvements to the agribusiness investment climate.

To access the state and national grants for, ABPF will provide technical assistance to farmer groups, producer organizations, processors, input suppliers, and other value chain participants to review their commercialization options and prepare viable business plans and investment proposals for funding under the these grant and also accessing commercial credit for other value chain participants.

Sub Component 2B: Market Infrastructure, Information and Intelligence Services

The availability of market information services through Kiosk, SMS, future pricing, etc. will help farmers reap higher benefits by improve the productivity and quality of the agricultural produce mainly through technology dissemination, integrated farming system approach, training and capacity building of farmers, market information and intelligence. Farmer will be provided market information about arrivals, prices, and quality standards of various commodities, not only from one market area, but from other market areas in the country and if possible from various countries of the world. This will enable the farmer in the clusters to have increased access to the markets and will be able to get better prices. This sub component added under re-structured mode of the project, wherein:

i. Though abundant information is available, however information accuracy, reliability, consistency, standardization and timely accessibility are the major challenge.

ii. Market Information and Intelligence Services (MIIS), will be set up under PPP approach, if possible covering both agricultural and livestock commodities.

Project will support for solution building (building a ecosystems comprising of processes, systems, resources, quality checks, analytical tools, etc.) and solution access (through a combination of ICT enabled platforms and traditional dissemination approach – SMS services, dynamic and real time market information displays, commodity outlook reports) e.g. Large scale successful pilot under Bank funded NAIP.
Market Infrastructure

Marketing infrastructure is essential for remunerative and cost effective marketing of agricultural produce. Infrastructure such as wholesale, retail and assembly markets and storage, helps to optimize the cost through minimizing post-harvest losses. They also add to the shelf life of the produce. Market infrastructure is required at all stages of the supply chain, from local retail and assembly markets through to wholesale and retail markets in major urban centers.

Market infrastructure needs huge investments which mostly come from Governments, public and private institutions. Still government holds most part of investments in compare to the public and private sectors. This makes a huge challenge to government bodies to use and maintain this infrastructure in the best interest of producers and here they lacks on many parameters. As a consequence markets are often congested, unhygienic and inefficient. They are also fire risks. Local authorities frequently see markets as revenue raising opportunities, not as institutions that necessitate investment. Although there have been significant developments with regard to supermarket development and the improvement of farm-to-agro processor linkages, the great bulk of food products are still distributed through more traditional channels using traditional market infrastructure.

Core Activities

- Financing/ Co-financing demand-based sub-projects proposed by farmer groups, and producer organizations
- Helping in building strategic linkages with value chain partners through supporting demand based sub-projects
- Supporting farmer groups with matching grant investments in rural market infrastructure and for productive infrastructure such as storage facilities, grading and sorting equipment, collection centers etc.
- Providing a comprehensive package of economical and technical services to producer companies involve in trading of inputs, marketing of produce and processing. This will be done by specialized business support organizations. (Who will outsource them? ABPF or PMU. How cost component for the same will be incorporated in the overall budget?)

Agribusiness support will provide producer organizations with matching grant directed towards agribusiness support and will co-finance investment proposals from producer organizations and producer groups established under the project and that are actively seeking to expand their operations. Proposals that qualify for matching grants will have one or more of the following general characteristics: (i) provide clear linkage through formal contracts between producer organizations and agribusiness/ value chain participants and (ii) have some public good character that benefits many participants in a value chain. The grants provided under these activities will be supported at 50% of costs with 50% contribution in cash from beneficiaries.

Functions:

1. To provide support in creation of additional agricultural marketing infrastructure to cope up with the large expected marketable surpluses of agricultural and allied commodities.
2. To promote competitive market infrastructure through private and public sector investments that sustain incentives for quality and enhanced productivity thereby improving farmers’ income.
3. To promote direct marketing so as to increase market efficiency through education in intermediaries and handling channels thus enhancing farmers’ income.
4. To support the efforts to develop infrastructure facilities for grading, standardization and quality certification of agricultural produce so as to ensure price to the farmers commensurate with the quality of the produce.
5. To promote grading, standardization and quality certification system for giving a major thrust for promotion of pledge financing and marketing credit, introduction of negotiable
warehousing receipt system and promotion of forward and future markets so as to increase farmers’ income.

6. To promote direct integration of processing units with producers.

**Marketing infrastructure broadly may include:**

1. Functional infrastructure for collection/ assembling, drying, cleaning, grading, standardization, SPS (Sanitary & Phytosanitary) measures and quality certification, labeling, packaging, ripening chambers, retailing and wholesaling, value addition facilities (without changing the product form), reefer vans, or any other refrigerated vans used for transporting agricultural produce, which are essential for maintaining cold supply chains etc.

2. Market user common facilities in the project area like shops/offices, platforms for loading/ unloading/ assembling and auctioning of the produce, parking sheds, internal roads, garbage disposal arrangements, boundary walls, drinking water, sanitation arrangements, weighing & mechanical handling equipments, etc.;

3. Infrastructure for Direct marketing of agricultural commodities from producers to consumers/processing units/ bulk buyers, etc.

4. Infrastructure for supply of production inputs and need-based services to the farmers;

5. Infrastructure (equipment, hardware, gadgets, etc) for E-trading, market intelligence, extension and market oriented production planning; and

6. Mobile infrastructure for post-harvest operations (excluding transport equipment) will be eligible for assistance under the scheme.

**Market information & Intelligence services:**

Rajasthan is blessed with diversified agro-climatic conditions; it lags behind in terms of production and productivity aspects. This coupled with poor post harvest management and processing prospects offers a bleak scenario for marketing as well as trade. Better marketing with increased and assured remunerations is the need of the hour to foster and sustain the tempo of rural economic development. For bettering marketing prospects in agriculture, market intelligence (MI) needs to be bettered. Keeping this in focus, this sub-component deals with the common misconceptions of MI in agriculture, the common challenges and implications that prevail before MI and the role that government plays and should play for improving MI.

The edge that only MI could offer to the farm community in the changing times of consumerism is also important. MI in agri-business should lead in establishing and bettering marketing and agro-processing linkages between farmers/farmers' groups, markets and private processors which in turn would make agriculture a more viable proposition.

If the information on commodity prices prevailing in various markets is made available, the farmers would be able to get better price for their produce by moving their produce to the market which pays higher price.

**Core Activities**

The availability of market information and intelligence services through Kiosk, SMS, future pricing, etc. will help farmers reap higher benefits through improving the productivity and quality of the agricultural produce mainly through:

1. Aggregation and segregation of agriculture market information and intelligence
2. Technological dissemination of market information and intelligence
3. Integrated farming system approach through informed decision making
4. Capacity building of farmers through information sharing
Functions
a) Dissemination of Market information and Intelligence through technology based innovative platforms.
b) Linkage with the institutions providing market information and intelligence
c) Aggregation, segregation and analysis of market information
d) Identification of new markets and technologies
e) To identify new trends in markets
f) Minimizing price risks through price tracking and trend analysis for decision making
g) Information for better market selection & positioning and to understand and discover untapped or under-served potential in agriculture
h) To give quicker, more efficient and cost-effective information

Project will consider options for creating a sustainable market and agricultural information service, as well as providing reliable information to the field extension offices. The main options will be:

i. A public-private sector partnership in relying on outsourcing of Information and Communication Technology (ICT) services to private institutions;
ii. Leveraging new software for large scale SMS broadcasting.
iii. Linkage with institutions which are involved in aggregation and segregation of agriculture market information and intelligence
iv. Development of ICT centers at cluster level or any other suitable and feasible geographical unit.

Mechanism of information dissemination
i. SMS, query redressal system, call centers, price tickers, community radio stations etc.
ii. Collaborations to bring markets to farmers though commodity exchanges.
iii. Collaborations to build supply chains to the existing processors/ retailers etc.
iv. Enabling farmer collectives (producer companies, farmer business groups, etc) in order to strengthen them and increase information flow to take informed decisions.

The farmers have to have access to market and marketing information and therefore project design also includes the interventions of technology transfer and market led advisory services and market information dissemination to farmers.

Farmer will be provided marketing formation about arrivals, prices, and quality standards of various commodities, not only from one market area, but from other market areas in the country and if possible from various countries of the world. This will enable the farmer in the clusters to have increased access to the markets and will be able to get better prices

The components for market information would be as under:-

Marketing Information at cluster level
- Marketing prices
- Price forecasting information.
- Agri-watch – Mobile Services
- Information Kiosk
- Farmer’s visits
- Training
\begin{itemize}
\item Extension
\end{itemize}

\textbf{Market intelligence services}
\begin{itemize}
\item “Mandi prices” which are nearest, accessible and iconic in terms of deciding market price.
\item Addressing the market risk- One of the ways to address market risk is to provide choice to the farmers by giving alternate channels to sell his produce. The information about prices in various markets shall be displayed at the aggregating centre which will allow farmers opportunity of making informed choice for selling their produce and getting higher profitability.
\item Future prices through price tickers – helping the producers to make decision on selling
\item Accredited warehouses and spot exchange terminals thereby reducing the transport cost
\item As a part of market information, data on commodity arrivals, quality parameters, facilities, will be displayed at the farmers common service centre as planned in the project. As a result of aggregations and segregations channels of transport will be developed with the stake holders in the value chain.
\item Information on payments, commissions, costs, etc. will be collected and displayed at FCSC.
\end{itemize}

\textbf{Sub Component 2C: Warehouse Receipt Development and Virtual markets}

This is a new component, which is introduced in the re-structured mode of RACP. It will be ensured that the selected food grain producing farmer will store the produce in the go-downs of Rajasthan State Warehousing Corporation (RSWC), avail credit from the banks through the warehouse receipts and have the option to sell the food grain through the commodity exchange at a future date with marginal returns. Earlier, it has been experienced that at the grass root level, farmers are not fetching requisite prices of their produce from the markets. This may be because of prevalence of various market forces into action and poor capacity or holding of the farmers to keep their produce for times having potential for good returns. Under this Sub Component, following activities will be taken up:

\textbf{1. Price Risk Management Services:}

To improve price risk management services for farmers in conjunction with commercial banks, and Rajasthan State Warehousing Corporation (RSWC) to provide farmers with high quality storage, access to finance through warehouse receipts, and option to sell via commodity exchanges, project is supporting modernization of warehouse, including setting up of laboratory services in select locations. Project will support famers/producers, producers groups to highlight the benefits of scientific storage, and access to warehouse receipt credit from commercial banks. With a focused extension and partnership with commercial Banks, there will steady increase in number of farmers opting for storage and warehouse receipt finance.

Both within and nearby the identified clusters, detailed survey and investigation of extent, availability and present status of following areas will be conducted to enable the project to prepare relevant plan of activities; focusing different commodities as per location specific requirements:

I. Traditional Agri-commodity markets:
II. Alternative Markets Objectives and Scope.
III. Local aggregation & farm-level processing.

Price forecasting measures of important commodities, input requirements/ arrangements, technology transfer on production aspects for increased productivity, post harvest management, value addition, transportation and storage of agricultural produce, and capacity building of the Farmers / CBOs on will be done.

Though storage in an accredited warehouse, combined with warehouse receipt financing, provide producers the flexibility in timing sales, the importance of knowing when to sell the produce becomes that much more critical when there is sharp fluctuations in the commodity prices. The
common misconception is that, produce stored for longer period automatically fetches higher margin. As per past studies under MACP, longer storage period need not necessarily lead to higher margin.

2. Institutional Building and Strengthening:
This will be the hard core soft activity of the sub component, wherein Farmer/Producers groups (PGs) and Producers’ Associations (PAs) will be formed. As a general rule, 15 farmers will be included in one farmers/ producers group and 20 farmers groups (300 farmers) will be included in one producers association. Farmers/Producers Groups and Producers Associations will be linked with the accredited warehouses of Rajasthan State Warehousing Corporation (RSWC) for the purposes of warehouse receipt financing and/or electronic spot trading. Awareness generation activities for these groups and associations will be organized. These groups, associations and also the workers/staff of RSWC go-downs will be given adequate and consistent training and capacity building and hand holding support from the project. One Farmers’ Common Service Center (FCSC) shall be established in each Producers Association.

3. Modernization and up-gradation of selected state warehouses:
Warehouses owned by the RSWC, shall be selected for financing the activities under RACP for setting up of Food Grain Analysis Lab / commodity testing laboratories requiring various equipment and machines, purchase of computers and commodity exchange ticker displays, grading and sorting facility and electronic weighing scale / machines in these warehouses. Assistance to the RSWC will be given in the project to undertake investments in their selected go-downs. The successful implementation of this activity will result in

   I. usage of large no of go-downs for storage purpose,
   II. increase finance under warehouse receipt and
   III. increase in trade on commodity exchange.

The project will also support for repair of go-downs including floor / wall finishing, turbo ventilation, Pucca construction work, chabutara, colour & paint etc.

4. Tie up with electronic spot market:
NSPOT, which is the leading National Spot Exchange in India; offers trading platforms for trading in a host of commodities, both agricultural and non-agricultural to various market participants. Most of the trading is done by traders and processors. To operationalize the model for farmer’s participation in electronic spot exchange on pilot basis in Rajasthan, all possibilities shall be explored in consultation with RSWC.

Virtual Wholesale Spot Trading of farmer stored produce:
The pilot on converting the storage locations of RSWC as “virtual wholesale market” with an objective of creating an important alternative to the traditional regulated markets. Under MACP project in Maharashtra, in partnership with NCDEX Spot Exchange Ltd. (NSPOT) about 700 MT of farmer’s stored soybean, at Latur MSWC warehouse, was sold through this electronic spot market from January 2014 to May 2014. A successful pilot, with participating farmers realizing better returns if they had sold the same commodity on the same day in the traditional wholesale market. The additional gain was both due to transparent price discovery process and efficiency gains. In this pilot, both non lien marked goods and lien marked goods were sold through trading of the Warehouse Receipt (WR). For goods that were pledged with the banks (lien marked), sale proceeds were first settled against the farmer’s liability with the bank (against the respective WR) and the balance amount was settled with the seller. This model will be adopted in RACP while working with RSWC.

Progress of increase in number of farmers accessing warehouse facility and warehouse receipt finance will be measured on following parameters:

   I. Number of warehouses where ware house receipt has been rolled out (Numbers)
II. Number of farmers availing storage facility (Numbers)

III. Volume of goods stored by the farmers (Thousand MT)

IV. Value of warehouse receipt funding by farmers (INR Crores)

V. Number of traders availing storage facility (Numbers)

VI. Volume of goods stored by the farmers (Thousand MT)

VII. Value of warehouse receipt funding by farmers (INR Crores)

Component 3: Farmer Organization and Capacity Building

This component will support:

(a) Mobilization and establishing of farmer groups and capacity building for participatory planning and plan implementation;

(b) Strengthening of institutions and human resources associated with the project implementation (i.e. participating line department and other relevant agencies);

The project promotes a range of community/farmer based organizations at the cluster level. These organizations will play a critical role not only in managing and maintaining the different project interventions, but will also be made economically and institutionally self-sustainable over the project period to carry on the project activities after the project period. The community based organizations (CBO) proposed will be organized around the three themes of the RACP- water resource management, agriculture, and value chain development. A specific household/farmer can be a member of each of these thematic CBOs organized around common interest groups, depending on their participation in different activities. Since the community mobilization and collective organization process is inherently slow, as it requires wide participating and institutional norm setting, the formation of CBOs will be a continuous process within the clusters throughout the project period and parallel to all other interventions. Further such community mobilization requires special methodology and skill sets often not residing in mainstream government systems. Therefore the project envisages that this function will be carried out by specialized service providers such as an NGO at the cluster level and will also supported from a designated technical assistance organization at the state level that will provide training and capacity building support at the cluster level.

Community Organizations

Implementation arrangements at Community level

Community Based Organizations (CBOs) for effective Water Resource Management: The three scenarios for water in different clusters, i.e. Surface Water (canal), Ground Water and Watershed (Catchment or upper catchment of Irrigation Project as per feasibility) will require different forms of CBOs to effectively conserve and manage these water sources. While the basic community mobilization process in each of these is somewhat similar, they will be further codified in the community operation manual (COM) and operational guidelines (OG) being prepared by the project. The structures of the CBOs proposed for each water source will be as follows:

a. **Ground Water:** Building CBOs for rational ground water management is the most complex of the institutional structures proposed because while the basic source is fully a public good (the aquifer) all extraction of water is fully privatized (bore wells). At the village level Producer Groups i.e. Multi Task Groups (MTGs), Gram Panchayat Level Committees (GWMCs) would be formed. The GWMCs would include all farmers using ground water for irrigation, drinking and other purposes and hence will be fairly broad based. The GWMCs will take up issues of groundwater usage and through education and peer pressure move towards regulation of sustainable ground water extraction. This also allows for integration of such a committee into the broader PRI institution of Gram Panchayat. These GWMCs will be federated into a hydro geologically compact area level federation for the entire pilot aquifer area, namely Ground Water Management Association (GWMA).

b. **Watershed (Catchment or upper catchment of Irrigation Project as per feasibility):** Mobilization of CBOs for watershed management is proposed at village, Gram Panchayat and Watershed level. At the village level Producer Groups i.e. Multi Task Groups (MTGs), Gram
Panchayat level Multi Task Association (MTAs) and Watershed Level Producer Organization would be formed. Special attention needs to be given in the mobilization process for inclusion of upland farmers residing in hamlets, who are also poorer, and farmers having land far from common water catchment structures such as anicuts (check dam) etc. Gram Panchayat level Multi Task Association will also be responsible for common land management.

c. **Surface Water:** Surface water management principles are applied in canal irrigated areas and Water Users Organizations (WUOs) will be organized to manage the specific canal networks of a larger canal irrigation system. At the village level Producer Groups i.e. Multi Task Groups (MTGs) would be formed. There are many examples of successful WUOs being formed within Rajasthan through the on-going World Bank assisted project and the best practices from this project will be used. The WUOs essentially take over the maintenance and water distribution system of the nascent networks under their area of operation of a larger irrigation system and, with training and capacity building can be assisted in better canal maintenance systems and a rationalized system of on farm water use.

**CBOs for Sustainable Agriculture** - As already explained in water theme Producer Groups i.e. Multi Task Groups (MTGs) will be formed for Agriculture, Horticulture and Animal Husbandry related activities. One of the core themes on which RACP will work is the promotion of water conserving irrigation and cropping practices. These will be promoted through Farmer Common Service Centres, Information, Communication and Technology (ICT) based activities, establishment of commodity based Centre of Excellence and on farm demonstrations of integrated irrigation-farming-crop choice packages. While this will not require formal farmer organizations to be established loosely organized farmer groups/clubs will be key to the success of such adoption. Such farmer groups will be organized across crops and farming practices first at the village level and then across villages.

**CBOs for Value Chain Development:** Farmer Groups/Producer Companies & Cooperatives: One of the essential components of value chain development directed at higher farmer returns is the benefits that arise from economies of scale through collective organization- wholesale purchase of inputs; seed production and distribution; bulk storage and marketing; sorting, grading and other post-harvest practices. All these functions require some form of collective organization that is currently managed through layers of intermediaries. Successful large scale collective organizations of farmers have been formed in other Bank supported projects in India, particularly the Producer Company model in MPDPPIP. The mobilization of such primary producer groups in the first stage and then their expansion and formalization into producer companies involves creation of a structure of farmer shareholders who buy equity; election of a board of directors by shareholders to manage the group/company; preparation of business plans; linkages with formal credit channels like banks for additional finance; appointment of village level shareholders as agents for collection and distribution; and staffing through professionals over time, among other activities.

The project cycle and the thematic interventions over different stages of the project are detailed out in tabular form (Attachment-1).

**Implementation arrangements for Value Chain Development**

Farmer groups and Producer Company will be the main implementers and beneficiaries of the component. Special attention will be given to building the capacity of producer company’s internal management and creating and strengthening linkages and partnerships with agri-enterprises with a view to create a functional value chain. The implementation cycle would have four sequential but interlinked stages, viz., (i) social mobilization and farmer group formation (ii) farmer group nurturing and capacity building, (iii) formation of Producer Company, and (iv) handholding of Producer Companies.

**Farmer Groups and Producer Companies:** The members of the water user groups will be supported to federate at higher levels and undertake various functions in a self-sustainable manner. These federated structures referred to as farmer groups and producer organizations/companies will enable the cluster area beneficiaries to achieve both economies of scale and greater voice in
negotiating better services. The size and scope of a particular farmer group and producer organization will not be predetermined but will follow a demand-led process. This process would be facilitated by the project NGOs and the ABPF. At critical stages, NGOs will use appropriate indicators, such as membership attendance, membership strength, record keeping, membership growth and retention of members, and volume and value of marketed produce to assess group maturity and stability. The project has a clearly laid-out sequence of activities for the formation of farmer group and producer organization, that will guide implementation at the village and community level, which are detailed in the project implementation plan and community operational manual.

**Agribusiness Promotion Facility (ABPF):** The PMU will provide oversight and monitoring of the activities of the ABPF which will be operated by a consulting company. ABPF will submit regular progress reports to the PMU, who will give directions to ABPF so that their role is performed as per the contract. The contracted service provider will staff ABPF’s offices and manage ABPF’s on-going program of activities as per the contract. The likely staff composition of ABPF would include, among others, Agribusiness and Marketing Specialist, Value Chain Specialist, Policy and Finance Advisors, Agricultural Economist. Long term sustainability of ABPF will be ensured by taking over the function of ABPF by Department of Agriculture Marketing/RACP Society after project period is over. The Department of Agriculture Marketing/RACP Society will recover reasonable fees for the services it will render as ABPF after the project period, from the beneficiaries for training, project preparation and advisory service. Government of Rajasthan officers will be trained by ABPF under the project.

Market Infrastructure and Agribusiness Support: This process would be facilitated by the ABPF and along with NGOs will be responsible for facilitating the consultations, identification and development of proposal from farmer groups and producer organizations.

**Component 4: Project Management, Monitoring and Learning**

The objective of this component is to ensure the effective implementation of the project activities and monitor and evaluate project implementation progress, outputs and outcomes, building on implementation experience with a view of potentially scaling up approaches deemed successful under this operation across the state. This component will support: (i) establishment and operations of Project Management Unit (PMU), which will oversee and coordinate the activities of the implementing agencies of the RACP; (ii) establishment and operations of Project Implementation Units in the respective line departments; and (iii) setting up of a monitoring and evaluation (M&E) system for the project, including a project management information system and contracting an external M&E agency to monitor project activities and impact.

**Component 4: M&E and Project Management**

Project management, robust monitoring and evaluation (M&E) system with a view of potentially scaling up approaches deemed successful under this operation across the state; (d) building synergies and convergence with ongoing schemes from the Government of Rajasthan (GoR) and the Government of India (GoI) such as Rashtriya Krishi Vikas Yojana (RKVY)/National Agricultural Development Programme (NADP), the Mahatma Gandhi National Rural Employment Guarantee Scheme (MNREGS), etc. Development and pilot testing of production risk management tools in crop and livestock sectors will be supported under this component, in partnership with insurance companies and banks.

**Project Costs**

The total cost of the Project is estimated at US $ 166.5 million (Rs. 832.5 crore), out of this US $ 157.4 million will be financed on the basis of a 70:30 ratio by an International Development Association (IDA), credit (US $ 109.0 million) and GOR resources (US $ 48.4 million), while the remaining (US $ 9.1 million) will be funded through farmer’s contributions.

**Project Cost component wise (US$ Million)**
## Project Components

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<th>Components</th>
<th>Project Cost</th>
<th>Bank Financing (IDA)</th>
<th>% Financing</th>
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<td>A. Climate Resilient Agriculture</td>
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<td>B. Market and Value Chain</td>
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<td>C. Farmers' Organization and Capacity Building</td>
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