Understanding the Tribal Farming System in the Context of Climate Change

VAAGDHARA
KUPDA, BANSWARA

CONTENT

List of Figures

List of Tables

List of Photos

Abbreviation

CSB	Contour Stone Bund	SCT	Staggered Contour Trench
CCT	Continuous Contour Trench	SB	Stone Bund
D/S	Downstream side	DCB	Ditch-cum-Bund
DE	Diesel Engine	EM	Electric Motor
WHS	Water Harvesting Structure	HP	Handpump
SBM	Swachchh Bharat Mission	NA	Not Applicable
Fm	Families	DLT	Drainage Line treatment
FGD	Focus Group Discussion	FB	Field Bund
gm	Gram	PRA	Participatory Rural Appraisal
NGO	Non-Government Organization	M-ha	Million hectares
Ha-m	Hectare-Meter	ha	Hectare
WASH	Water, Sanitation, and Hygiene	cum	Cubic meter per day
LSCD	Loose stone check dam	MCD	Masonry Check Dam
m^3	Meter cube	%	Percent
q	Quintal	Rs.	Rupees
SWC	Soil and Water Conservation	SWT	Stone Wall Terrace
IGWDP	Indo-German Watershed Development Programme		
NABARD	National Bank for Agriculture and Rural Development		
pH	Potential of Hydrogen		
PIA	Project Implementing Agency	R&B	Rope and Bucket
VDC	Village Development Committee		
SALT	Sloping Agriculture Land Technology		
SLMT	Sloping Land Management Technology		

Acknowledgment

The study of understanding indigenous agriculture in the region of tribal-trijunction of the states of Gujarat, Madhya-Pradesh and Rajasthan, India, is the life-time learning to study team of VAAGDHARA and particular me as the team leader.

Nevertheless, I express gratitude towards Mr. Jayesh Joshi, CEO, VAAGDHARA, for providing us this opportunity to interact with the community on this vital topic. I am also thankful to other team members of VAAGDHARA for their kind cooperation and participation, which helped us in the completion of this project. I am also grateful to Mr. B. M. Dixit, Agriculture Scientist, to provide various technical insights related to commonly followed practices of community, without which it would have been difficult to explain the methods in their totality.

I am particularly grateful to managers, leaders, and other field level functionaries of Jan-jatiya Swaraj Sangathan spread over in three states. As a team leader, I am fortunate to interact with the indigenous communities within the VAGAD region particularly women leader of Saksham Samuh, I am thankful to visionary farmers like Mr. Ruplal, Hagsi Bhai, Parmesh Bhai, Pacha Bhai, Reshma Bai, and many more who shared with us different aspects of the age-old farming practices and enlightened us during the whole process of community consultation. Without their knowledge and experience, the study wouldn't have taken shape in quality of outcomes, and thus their support has been essential.

Sincerely,

Deepak Sharma

Preface

The Indian subcontinent is known for its varied topography, varieties of soils, and diverse ethnic groups. These, with variations of climate and especially of rainfall, create several different regions, each with a distinct character of its own. Various studies have captured farming diversities in different agro-climatic zones and topographical. But there are limited documents about farming systems of indigenous communities, particularly those who are not known for their agriculture expertise. To fulfill this gap, VAGDHARA has tried to interact with indigenous communities in the tribal-dominated junction of Gujarat, Rajasthan, and Madhya-Pradesh.

Our discussions with farmers indicated to us that the present linear approach of farming adopted post-green-revolution had made agriculture a high input venture. In this context, farmers are hard-pressed to sustain their livelihoods, but Bhil farmers of remote regions like this junction of tribal communities could somehow survive their age-old food and farming systems. This document captured intricacies of farming in this remote, hilly, isolated region predominantly habituated by the indigenous community of Bhil. Therefore, to benefit new-generation farmers, we planned to document the farming system of Bhil and bring it to the world of scientists and development professionals for more comprehensive discussions and further upgrading. It is an effort to synthesize practices of generations in the form of cultural learning so that new generation farmers can bring out the sustainability characters of their precious food farming culture.

Traditionally tribal farming had always been a culture of farming and food culture. In a time where the whole world is facing lifestyle diseases, the food-farming culture of Bhil tribes gives us the strength to fight climate change-induced weather variabilities. The publication tries to assess tribal farming culture from the angle of sovereignty, which is at the core of the self-reliance thought of Mahatma Gandhi.

To consolidate more extensive learning of tribal communities in a small booklet is a Himalayan task and cannot be completed in a short time. Our dialogue with these farmers is continuing, and we have planned farmer-based action-research to bring-out scientific data to provide evidence-based back-up to these practices and potential innovations to further the age-old farming system of the Bhil community. In this connection, we request readers and farmers to please contribute your knowledge about this approach and help us enrich it further.

At this juncture, I would like to place my sincere thanks to Mr. B.M. Dixit, Chair-person, VAAGDHARA. I also put the contribution of various support organizations and Mr. Deepak Sharma for his efforts to consolidate learning in the form of this booklet.

Thanks!

Jayesh Joshi
Secretary, VAAGDHARA

1. Context

Agricultural operations involving crop production comprised (i) land and soil preparation inclusive of tillage and fertilization (ii) cropping system (iii) harvesting (iv) processing and (iv)preservation. All these technological aspects in Indian crop-husbandry are mainly available to us from the Vedic period and communities in different regions have evolved local variation since then. The predominant attitude of modern agriculture Community towards these variations is to try to convince farmers to give up their so-called backward agriculture and adopt more modern and high productivity agricultural practices. Often no attempt at all is made to try to understand the traditional farming systems and methods of local communities, more so far practices of indigenous Bhil communities.

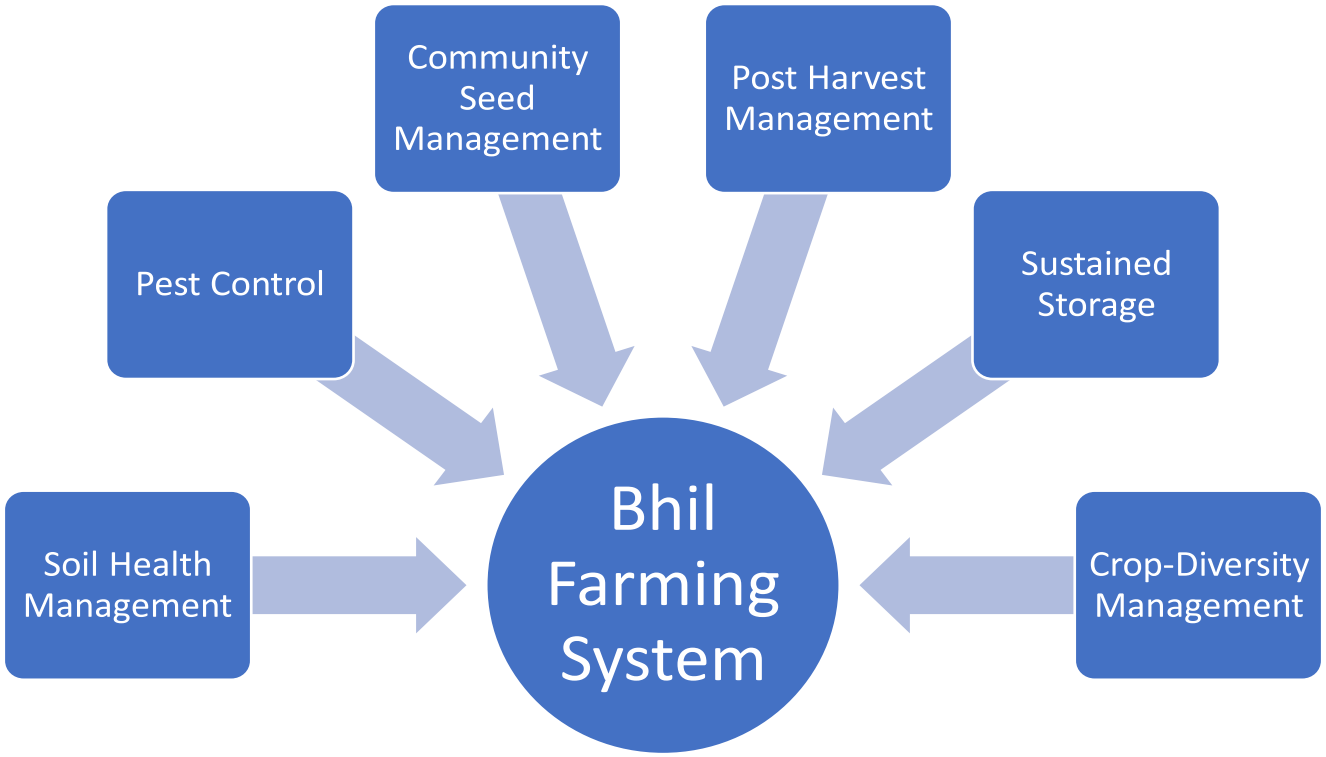

Figure 1 Dimensions of Bhil Community Farming System

The farmer's practices are considered as backward and hence in need of replacement by the readymade 'modern' solutions available with Science. However, this is not at all the reality as one see in many Bhil villages. Instead, what we see in these villages is an agricultural system Which is in harmony with nature as well as the food and nutrition need of people. Further careful observation reveals it to be a risk-minimizing system which can provide at least some food, even in adverse weather conditions. Hence the relevance of their eco-friendly zero-fossil fuel system has increased further in times of climate change and erratic weather. Traditional farming of Bhil community followed mixed cropping but under the influence of market and extension, they adapted the exploitative market controlled farming system, which brings them malnutrition and poverty.

2. Evolution of Exploration Study

The exploration process to understand the indigenous farming system of the Bhil community is a result of 15 years journey of intensive engagement of VAAGDHARA and its team members with the local community. Beside it, the field team undertook the following steps to capture specific knowledge about crucial practices. All the data thus generated is then compiled and validated through community-level discussions.

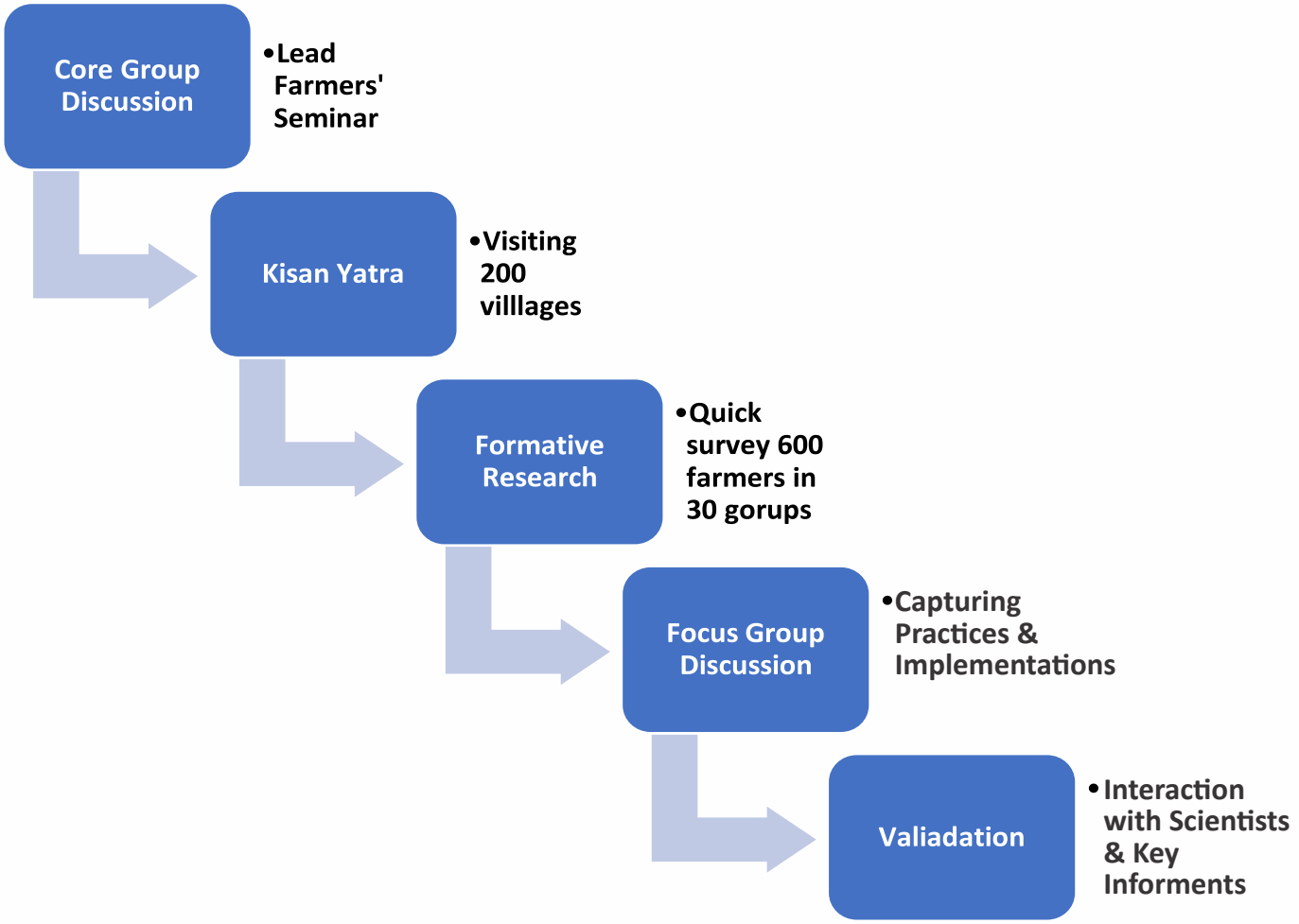

Figure 2 The Process of exploration to evolve this document

3. Overview of Bhil Agricultural System : Rajasthan, India

The Bhil's farming system includes different locations within a broader range of conditions (soil, micro-climate, slopes, natural vegetation, and biotic interference). Traditionally, Bhil families and their Bhil farming system have a large number of crop options. Earlier, proper management of forests used to maintain continuity in the supply of many foods. This food was completely free and hence, accessible to the poorest. Many problems among Bhil arise not from lack of traditional wisdom but due to multiple exploitation and disturbances (including displacement) they have to face due to outside forces.

To safeguard nature's changes, farmers of the tribe in this Bhil junction follow traditional practices that include a lot of diverse cropping. In the year 2017, crops in the area faced failure due to increased period of dryness, pest attacks, and untimely rains. But the farmers still think that nature should not be affected by farming methods thus, they prefer traditional farming methods every time. Mr. Amrit Lal, a Bhil Farmer of Mundari village in Banswara district, says that they heard stories about farmer suicides in different parts of the nation. He claims that his tribe never faced such situations even if when every crop is lost, and there is zero hope of survival.

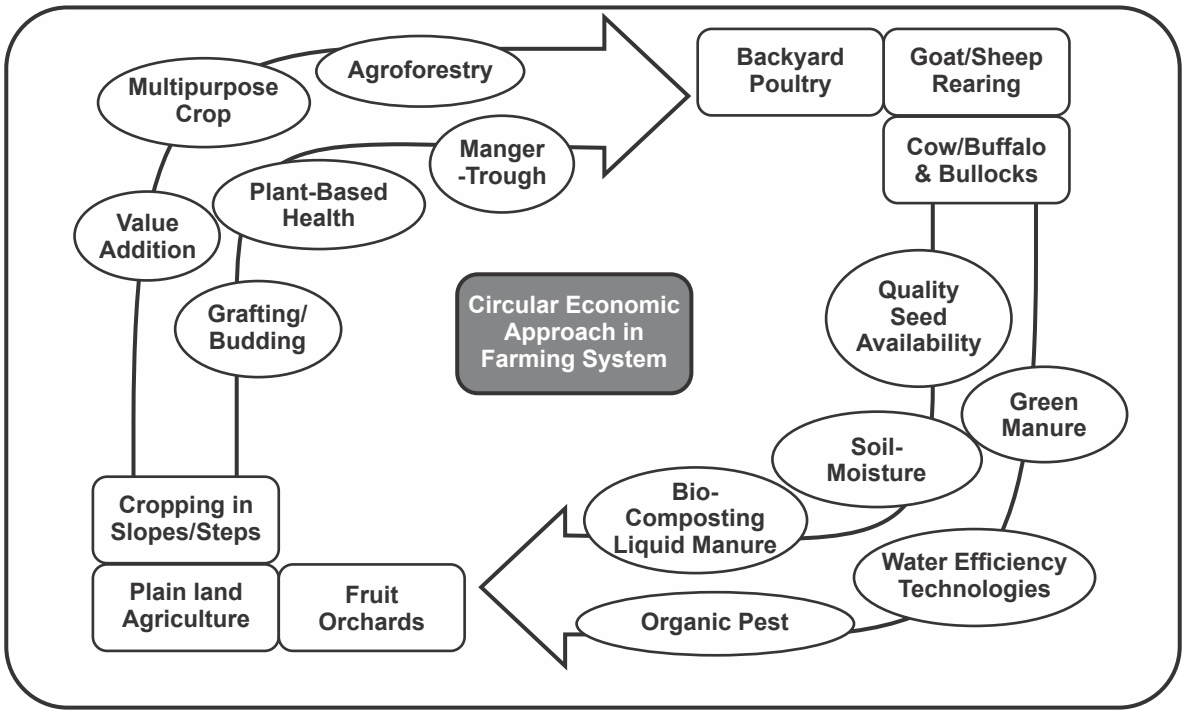

Figure 3 Circularity aspects of the farming system (Source : VAAGDHARA)

Agro-biodiversity in Bhil farming in southern Rajasthan constitutes crops sown by farming families with naturally regenerated plants within their system. Agro biodiversity in Bhil farming system has been the basis of subsistence for life over several generations providing Bhil communities with an enormous range of food, medicine, construction material, and other products.

In the past decade, the region has suffered natural calamities, one after the other almost every year. Experts say that the increasing frequency of natural calamities is result of global warming and climate change. The monsoon delays very often in this Bhil junction, which results in drought-like situations in the early Kharif cropping season. Some experts predict that crop yields may reduce due to severe warming, floods, and drought. An increase in the number of weed and pest, would also be harmful to crops unexposed in the past to these different ranges. This tribe usually raise their crops on lower hill slopes. Crops like millets, legumes, tubers, vegetables, pulses, sorghum and rice are grown throughout the cropping season and are harvested one by one from October to the February. This process happens every year.In the Bhil region, agricultural systems mostly based on traditional, cultural, geographical, and socio-economic factors. There are four well-recognized systems:

Photo 1 Different types of land-use category in a tribal region

3.1.1 Cropping in Slopping Lands (Maize-Pigeon Pea & Maize-Cotton Ecosystem)

Nearly 70% of land in tribal-dominated districts of these three states is sloping thus, most of the crops grown by Bhil communities are indicating soil type, slope, and climatic conditions of the area. This region falls under the sub-humid category and the average annual precipitation is around 900-1100 mm, which precipitates from June to September month. In sloping fields with longer rain duration, people follow row cropping with Maize-Pigeon pea and Maize-Cotton particularly in Anandpuri, Kushalgarh, Peepalkhunt and Danpur area. In this system, both the crops are sown at the same time but maize harvested in September end or October first week. Once harvesting of maize is complete, residual moisture is used by pigeon-pea for growth purposes, which flowers from November to February to get the second crop. Some people also grow cotton instead of Pigeon-pea.

Besides this system of relay-inter cropping, some families do follow cropping with Maize + Jalar + Blackgram + Cow-pea + Foxtailmillet + Rajan + Groundnut + Sesame + Chibda, which is a vibrant combination of all sorts of crops cereal, pulses, oilseed, leafy vegetable and vegetable.

Photo 2 Sloping agricultural field and set-up of typical Bhil house

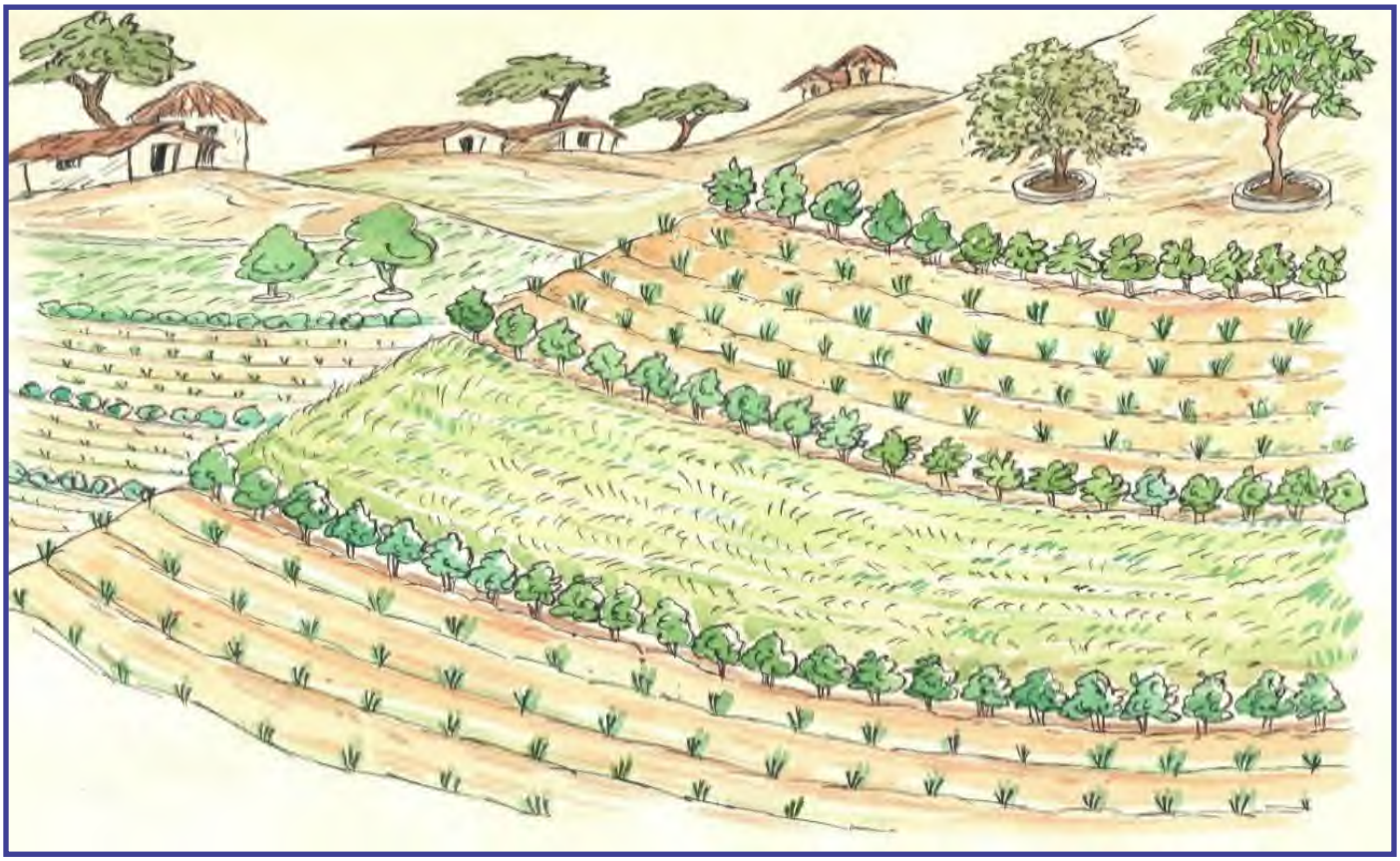

Photo 3 Sloping agricultural field of Bhil Family in the tribal junction study area

Photo 4 Cultivation sloping lands for wheat without land-levelling

Photo 5 Cultivating wheat on slopes, resulting in fast soilerosion

Some farmers do cultivate sloping lands for growing wheat, which are resulting in accelerated soil-erosion causing a threat to sustainability, recently added phenomenon to Bhil farming system. (Photo-5 and 6)

3.1.2 Beed Area Cultivation:

When a new area is developed mostly it follows a pattern of slash-burn of the North-eastern region of the country. In such land, the practice of mixed cropping with Maize and minor millets (Kodra, Kuri, Cheena, Hama, Hamlai,) as the most common crops is practiced Besides these cereal crops, some families cultivate Til (Sesame) and Jalar. Contour trench/bunding and field bunding are the practice of hilly slopes in tribal areas of Rajasthan is known to be very ancient practice for conserving soil nutrients, increasing cultivable area and develop resilience to weather variability.

Photo 6 Cheena Crop from Kushalgarh

Photo 7 Cheena from Ganesh, Udaipura-Bada

3.1.3 Step-Cropping (Terrace Cultivation) : Maize, Wheat, Gram, Barley, Mustard

Levelling of slopes of the hills carried out using stone bunds and manual cutting of the upper slope. Such bunds usually are created along the valleys, across the slopes. Commonly crops are planted across the slope direction. In such fields, widely grown crops are Maize, Chilli, during Kharif and Wheat, Barley, Masur, and Gram. Some other plants grown with Maize are Urad (black-gram), Chavla(Cow-pea), Chibda/ ValenKakadi (a local variety of Cucumber). In some stony valleys (valas), they do cultivate a variety of rice called Pathariya, as the name reflects, it is grown in stony fields and requires less quantity of water.

Photo 8 Arial View of a Bhil Farm

3.1.4 Talai Khet (Wet-Terrace in Valley) for Rice Cultivation (Talai)

Valley Portions are developed in the form of plain agricultural field by using stone and earthen field bunds with a small part of it as a spillway to take excess water out of the area. This is done to keep the crops partially submerged for some parts of the year The crop is then planted within this part and kept well irrigated. It is carried out mostly in the reified low-lands in valleys of Bhil regions, particularly in Anandpuri, Bagidora, Kushalgarh, Sajjangarh, Ghatol, Peepalkhunt, Danpur, Thandla, Banja, and Petlawad, etc. Beside this, some plane regions of Garhi-Partapur and Sagwara are also cultivated under this category. In this region, Rice paddy cultivation is followed by wheat, and Gram. Some people do cultivate Barley and Mustards these days.

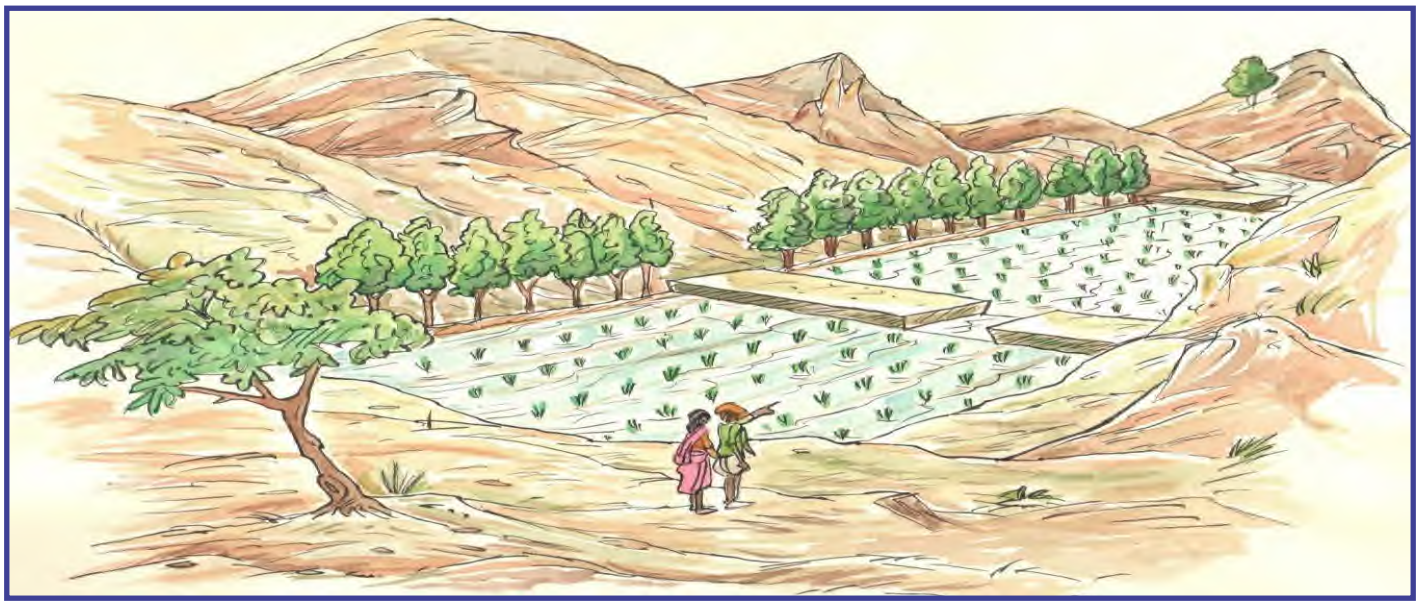

Photo 9 Talai Khet of Bhil Community, developed through generations

3.1.5 Home Garden Area Cultivation :

Utilizing land around house, road, bada, Bhil farmers do not need even hal and bail (plough and bullocks)—a sickle, an ax and a khanti (crow-bar like tool) are enough, which causes very little soil disturbance, maintains plant distance.Homestead lands are usually protected with creepers around the home boundary (Handeda), including tindori, Balore, Sem, Jalar.These homestead areas serve as store-house of vegetables for immediate home consumption; this includes chili, dheemda, dhimadi, turmeric, brinjal, etc.

Talai (Vala Fields) - WET RICE CULTIVATION

- Wet Rice Cultivation
- Winter - Wheat, Gram, Barley, Mustard

Steeping (Terraced Fields)

- Pathariya (Dryland Paddy)
- Maize, Soybean, followed by Wheat, Barley, Gram, Mustard
- Maize-Jalar; cow-pea; black-gram, Cucumber etc
- Tuber crops - Potatoes, Ratalu,

Sloping Land Cultivation

- Maize-Pigeon pea;
- Maize-Cotton
- Mixed Cropping

Beed Area

- Maize, Millet (Kodra, Kuri)
- Cheena, Hama, Hamlai
- Sesame

Home Garden (Badi)

- Chilli, Bean, Brinjal, Ginger, Garlik, Onion
- Pumpkin, Bottle-Guard, Papaya, Banana,
- Dhimda, Dhimadi, Rajan
- Custard Apple, Lemon,

3.2 Cropping System

Within each agricultural system, there is an extensive range of crop types as well as physical and temporal arrangements. In different regions and communities, cropping systems are mainly dependent on traditional, geographical, cultural, and socio - economic factors.

Mono-Cropping: A single crop is grown in one season and produce the same crop, again and again, every year. A crop like Rice, Maize, Soybean, green-gram, gram, and wheat are mono-cropped. (Photo-10) Mostly it follows uses for high-yielding varieties and cash crops, which usually are more susceptible to total crop failure due to pests and diseases.

Photo 10 Monocropping Maize in the upper field and paddy in a low-lying region

Multiple Cropping: When two or more crops are grown on the same plot of land during a single year or say single crop seasons, it is various cropping. It helps in following; a) Optimising the utilization of natural resources like land, water, nutrients and sunlight, b) Increases the annual net yield per plot, and c) Avert total crop failure due to pest, diseases, or insufficient rainfall. Multiple Cropping includes the following;

Mixed Cropping: Many crops are grown randomly in a single season and single plot. In this region,the best example of mixed cropping is in the form of Maize, Jalar, Cowpea, Sesame, Kaang, Okra, Cucumber (Chibda), Rajan, Dhimda, etc. The traditional mix cropping does not follow a specific pattern, except for mixed sowing. We tried to find out the rational of mixing different crops, but farmers were not able to come to any solid conclusion.

Inter-cropping: Two or more crops are grown together at a given time; the planting is done in a specific manner to ensure optimum growth and yield. For example, crops can be grouped or planted in rows depending upon the varieties involved. Maize-Jalar; Maize-Cowpea; Maize-Soybean, Maize-Paddy are inter-cropped in this manner. (Photo-11 & 12)

Photo 11 One-line Maize & One-line Cotton

Photo 12 Three / Four lines Paddy & One-line Maize

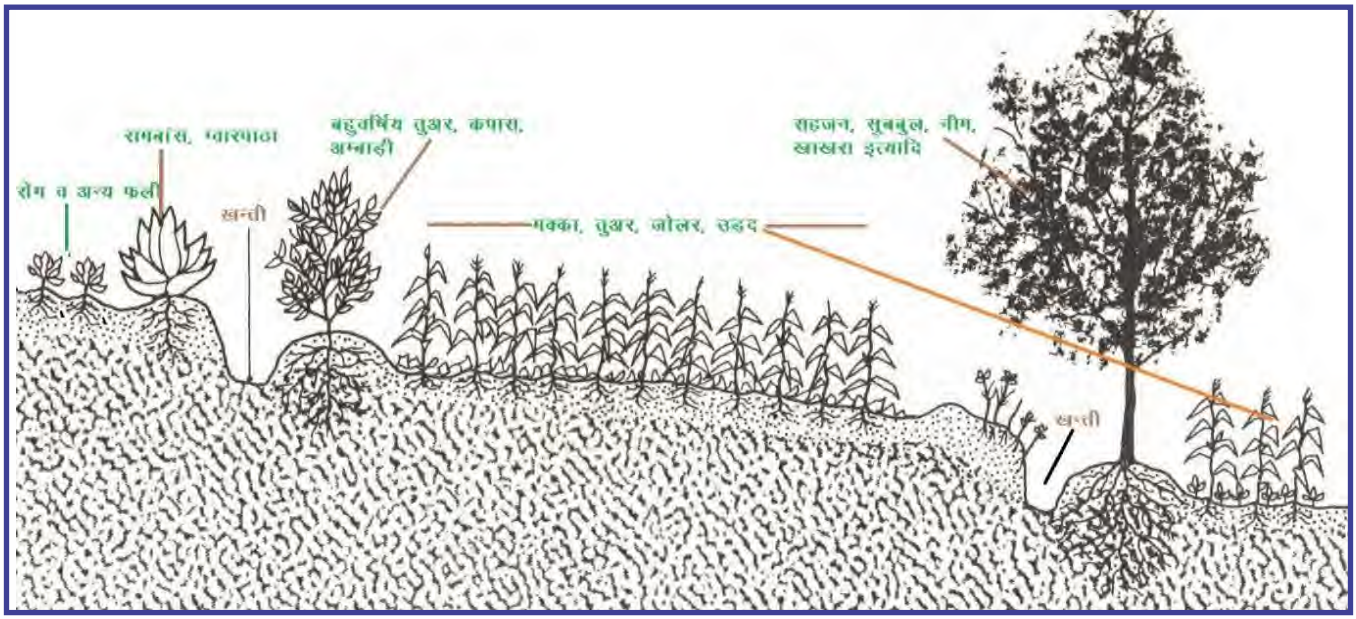

Photo 13 Cross-Section of a sloping land

Sequential Cropping: Two or more crops are grown in succession in a single year; for example, Soybean followed by wheat, Maize followed by wheat or Rice (Paddy) is planted first followed by wheat/gram. (Photo-15)

Photo 14 Paddy Crop in Road-side Cutting5

Photo 15 Bhil Farming system use bullocks (animal power) for various operations

Relay Cropping/Dual Crop: In this pattern, two crops are sown together in such a manner that first crop matures early and harvested, while second crops grow faster after harvesting of the first crop. It is also a kind of sequential cropping where the second crop is sown/planted before maturing of the first crop. In this region, Maize-Cotton, Maize-Pigeon-pea, Maize-Groundnut-Cotton follows this system. With this approach, one can cultivate two crops within an agriculture field where moisture is available beyond a rainy season.

Optimizing every-inch of land and everydrop of water Above all systems, Bhil follows optimizing use of resources and complies utilizing the land as per its capabilities. Photo-15 shares an example of this approach, from village Ghata, Sajjangarh, Banswara, which shows the cultivation of paddy in a pit dug for construction of a road in the village.

Photo 16 Intercropping (Maize & Groundnut) and Dual Crop (Maize & Cotton)

3.3 Traditional Erosion Control Measures and Rain-Water Harvesting:

Traditionally, Bhil community has been following a practice of using stone-bunds to collect soil from upper regions and develop agriculture fields across the valleys and along the valleys and flood plains. To protect land and water in private pasture lands, they have been practicing making of basins around existing trees, which are locally called thavla (Photo 20). Sometimes where stones are not available, earthen bunds are also applied to control the land-slope.

Photo 17 Earthen Field-Bunding

Photo 18 Staggered contour trenches

Photo 19 Talai Nirmal using stone-bunds

Photo 20 Tree Basins

3.4 Nutrient Management in Bhil Farming

The soil fertility depends on three factors: (a) conservation of topsoil, (b) replenishment of "soil exhaustion" caused by repeated cultivation of crops and (c) manuring of individual plants. The former is performed by bunding, by removal of sand silt and by weeding. Soil-exhaustion is removed by the application of manure, including green manuring, by rotation of crops, etc., composts of different materials serve the purpose of fertilization of land. All these practices are, however, noticed in Bhil agricultural practices in the area. Traditionally, Bhil farming system follows the application of goat-droppings, dung, and agricultural waste, which is collected, stored, and applied as part of farmyard manure. It is beneficial for replenishing soil exhaustion as it contains nitrogen, phosphoric acid, and potash. Some commonly followed practices are ;

- The use of pond silt helps in the improvement of soil fertility. Practices of desilting the ponds and dams have helped replenish the soil fertility on the one hand and with improves the water storage capacity of ponds on the other side.
- Some farmers do spray Chhach (Butter milk) diluted with water (1:25) on the soil before sowing; they believe it helps in proper germination.
- Crop-rotation is well recognized among Bhil communities, but families having limited land holdings have evolved the practice of mixed cropping to include legumes in the farming system.

Photo 21 Flowering Sun-hemp

Photo 22 Sun-hemp ready for application

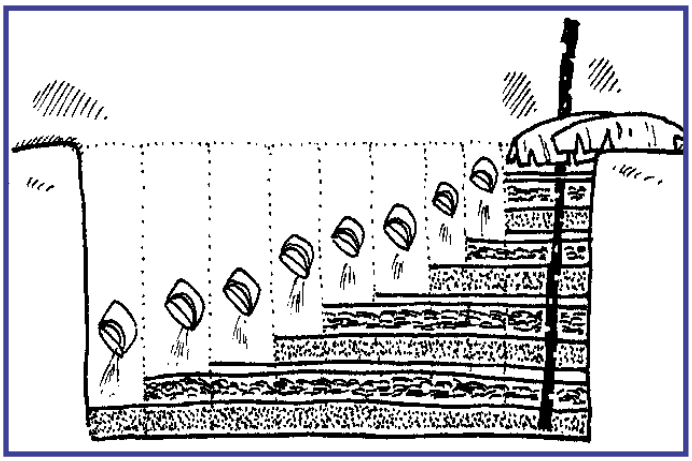

Photo 23 Composting in Pit

Photo 24 Pit for Composting

- A large number of Bhil families, while creating new agricultural land, will follow step by step soil health improvement plan, starting from the cultivation of sunhelp → sesame → clusterbean.
- If some moisture, is available a good number of tribal farmers sow gram during Rabi season, with the idea that even if they do not get a crop, they will get their field fertilized, as it's nodules will do nitrogen-fixing. This may be taken as an instance of the practice of green covering of fields to make it fertile.
- Green manures: Leaves and twigs of Palash (Butea monosperma) arid kanaj are collected from forest or commons and used for green manuring purposes, particularly for raising the nursery of Mal, Ginger, Chili, Tomatoes, onion, and Egg-plant.
- Manuring by cow-dung: The practice consisted of a scattering of dry cow-dung in the field before sowing of seeds.
- Some families do follow the modern system of composting (Photo-23), but most families follow simple pit for storing farm residue for preparing farm-yard manure.

3.5 Pest Management Practices of the indigenous community

Traditionally, the Bhil community does not bother much about the pest attacks they never considered it as an attack. Normally, the Bhil farmers don't do anything for pest control but to raise their fields and their surroundings as a food opportunity for wider family (sarva - parivar) including that of the grower, pests, insects, ants, flies, spiders, and birds. Most of them say, "As we grow crops, pests and insects come, the ants, flies, and spiders eat them. Birds, searching for food, also come to eat the flies and insects, followed by rats, snakes, mongoose, and the cycle continues"According to the community, frequentpest attacks are Chempa (Moila), Hara tela, Safed makhi, Thrips, Makri. Following are standard practices of indigenous people to control different insects/pests affecting conventional crops in the Mewar-Vagar-Malwa region

- Safed Makhi and Chempa, thus hanging grease/burnt oil plastered card in field controls whitefly, as it attracts whitefly, which gets stick to the card. Once a card is full of fly, collect and destroys them.
- Two-week-oldChhachh (Buttermilk), 100-150 ml mixed with 15-liter water, spray on Chana, Tuar reduces the effects of sucking pests like sundia (illi) and reduces the incidence of vector-borne viral and some fungal diseases gets controled.

- 50 kg Nimboli powder, 2.5 kg Tambaku powder, and 40 litersgaumutra soaked overnight and mixed with 400 liters of water to spray in one-hectare area.
- Many tribal families maintain Hazara/Gull Gatta (merry-gold) plants in their back-yard kitchen garden to control many pests.
- A sprinkling of ash on aphid infested vines of cucurbit, beans or maize, and various other diseases like white rust, downy mildew & powdery mildew in a mustard crop.
- Some families do use Hing (Asafoetida) powder put in fine cloth and tide around the lower rotted portion of bottle guard vine.
- Some elderly people reported that 10-litre Chhach kept in an earthen pot for a month, add half a Kg of wheat flour in it. Later dilute this mixture and apply to control chanakiill but not many people now do not practice it.
- Some people take a mix of 5 liters Gomutra, 1 kg Sitaphal Patti, 150 grams Tambakuchurna and 100 grams Lahsun, warm it in a copper pot and filter it. 100 ml of solution mixed with 10-liter water and spray to control insects.
- Commonly known wild plants known as pest repellents such are Vasaka, Datura,Jatropha, Custard Apple, Aloevera, Tulsi, Marua, Marigold, Karanj, Palash, Garlic, Turmeric, Dhudi, Saunf, Neem, Nirgundi, and Lantana.
- Cow Pat Pit (CPP), Amritpani, Panchgavya, and Agnihotra ash are recognized agents for seed treatment. Old Sanskrit literature describes many such methods and during recent years, their advocacy has been done even by renowned scientists.

Photo 25 Pest Control Liquid from Neem leaves

- But in the last two decades, some farmers have started adopting local level pest control measures shown in figures given below.

Following photographs gave approaches developed during the last decade to control some of the pest attacks in the crops. At the field level, these methods are captured; therefore, they are in Hindi. The approach of using cow-urine, neem/Aak/Bel leaves crushed mixed with garlic and water, particularly to deal with illi affecting cotton and gram. Though the community shared some quantity for different aspects, there are variations from place to place and family to family. (Photo 25, 26, 27, 28, 29)

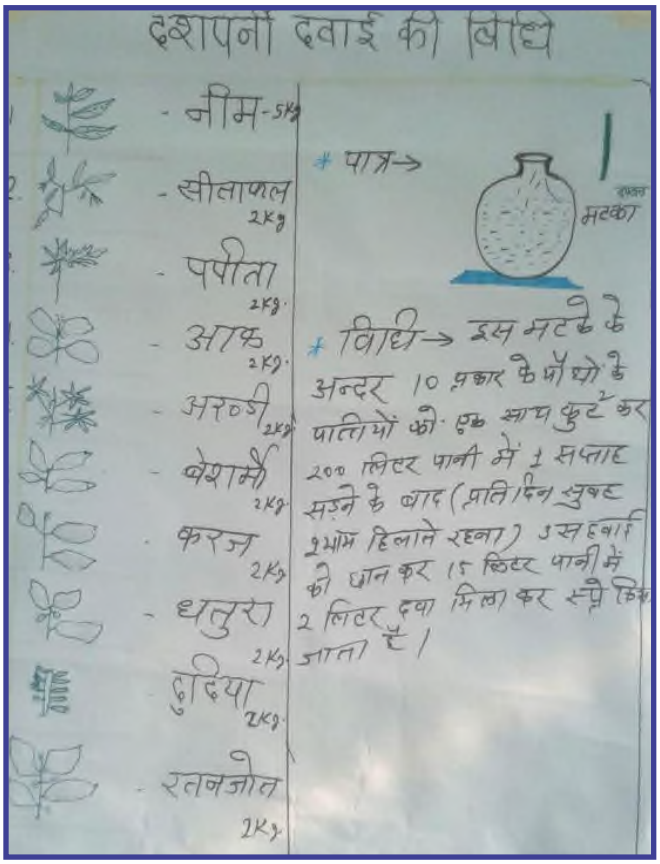

Photo 26 Steps for " Das Parni" Pest Control

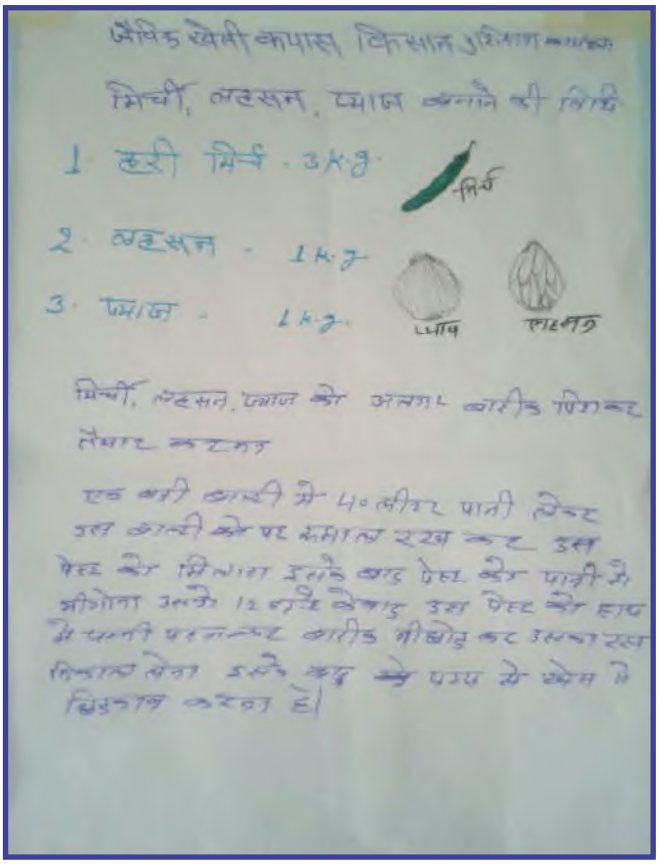

Photo 27 Garlic-Chili Based Pest Control

Photo 28 Cow-urine and other leaves

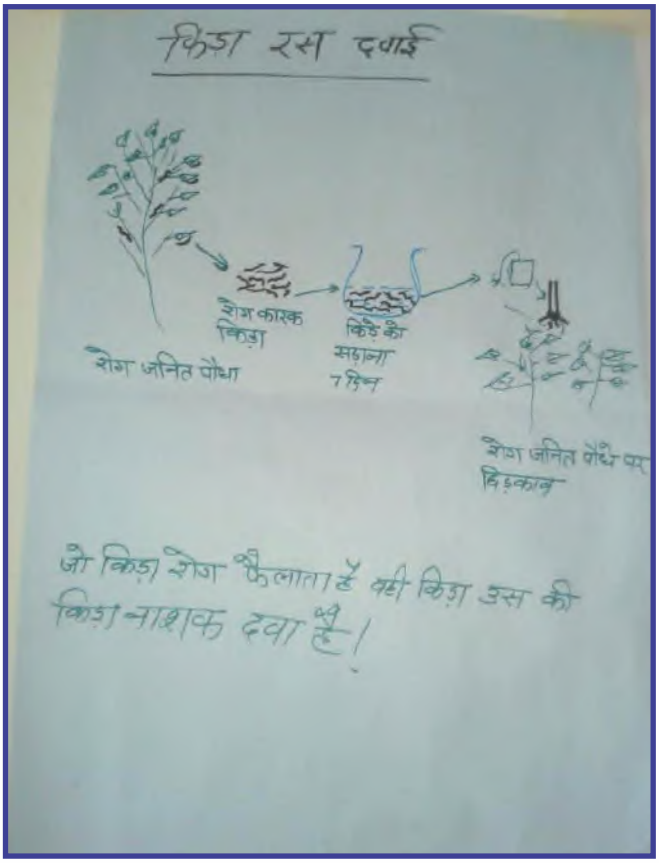

Photo 29 Using insect to prepare control juice

4 Sustaining Agro-Forestry

Bhil community shows their organic linkages with plants, trees, and forest, by adapting agro-forestry, family woods and also diverse plants around their homestead land.

Photo 30 Developing hedge-row for agroforestry

Photo 33 Sketch of some sites in Bhil - Farming

Photo 31 Contour trenching and bunding for plantation

Photo 34 Contour line of Su-Babul as agroforestry

Photo 32 Contour trench also used as a water channel

Photo 35 Photo Showing divers plants in an agroForestry

5 Traditional Agriculture Implements

Traditional farming system of Bhil community was very rich in agriculture implements, various operations Figure-4 shares different agricultural operations and associated specific implements for these operation specific implements targeted to them.

Cleaning	•Daranti, Kulhadi, Datedi, •Kas, Geti, Seepiya
Ploughing (Jutai) & Sowing	•Hal, Dhora, Tariyol •Perani,
Post-Sowing	•Pa, Vakkar •Hera, Hamado, Hamadi, Meda, Chavar
Inter-cultural Operations	•Kalapi, •Kudali,
Harvesting	•Danteda, •Khaliyaan & Kandol
Processing & Storing	•Hori, •Supda, Kabala

Figure 4 Common agriculture operations and linked implements

Photo 36 Ploughing, Sowing, and Inter-Cultural Implements

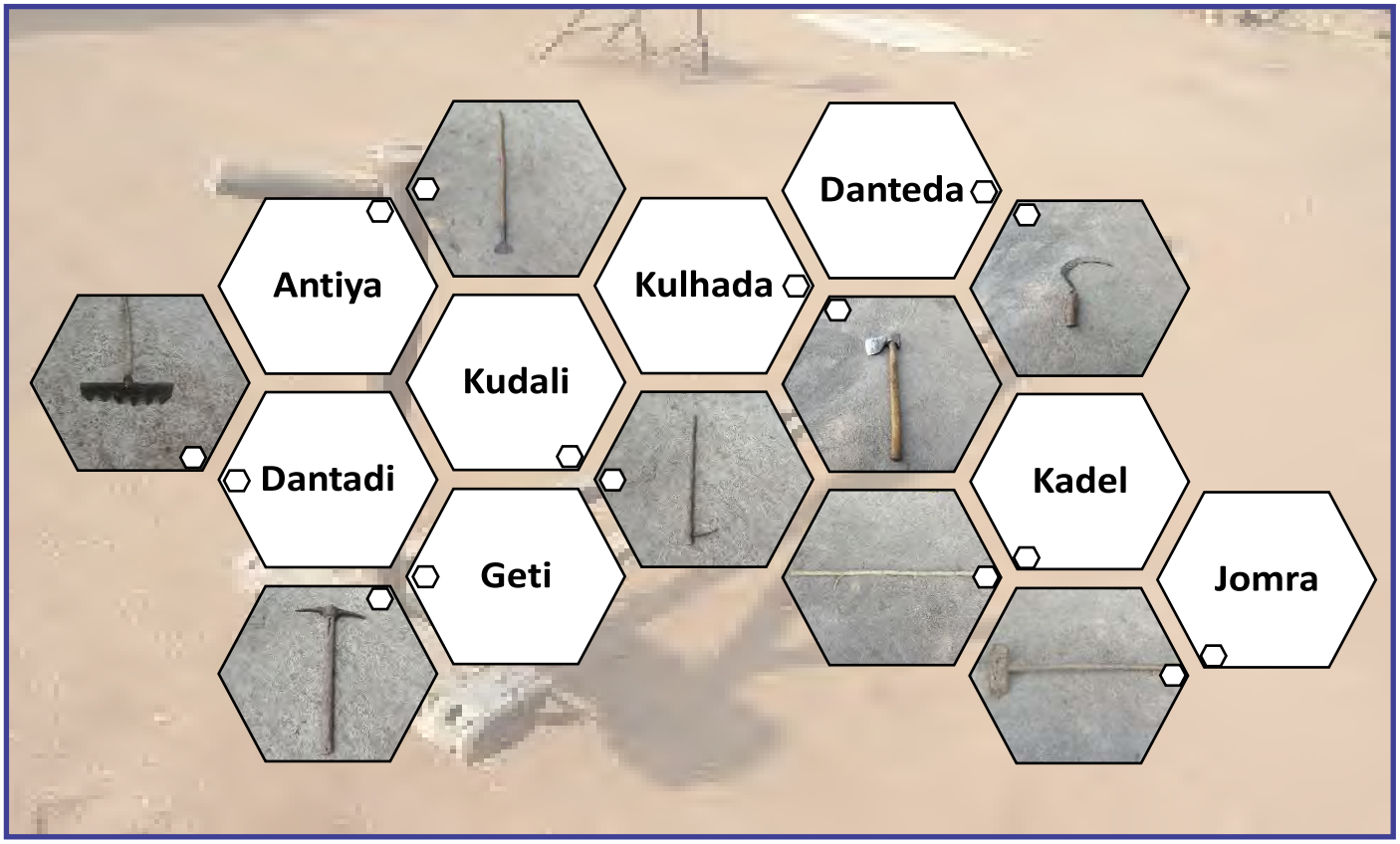

Photo 37 Other Minor but specific implements

6 Crop Diversity

VAAGDHARA team catalogued 26 types of cereals, 28 roots and tubers, 40 vegetables, 45 fruits, which one uses in various Bhil villages, practicing biodiversity rich agriculture. The bhil community also collects many kinds of food from forests on the basis of their knowledge about the plant and tree diversity The Study also brought out 36 kinds of uncultivated foods being harvested by villagers, mainly Bhil.

These families collected and also domesticated some of these uncultivated foods in and around farm boundaries, commons, and forest areas. The foods identified were categorized under various food groups based on their edible parts. A list of commonly consumed indigenous food items were compiled (including cereals, legumes, vegetables, leafy vegetables, seeds, fruits, and animal foods). During the whole process community-identified;

Traditionally Bhil farmers have grown 40 varieties of crops in any single farm. Their crop mix includes finger millet, paddy, foxtail millet, barnyard millet, pearl millet, sorghum, little millet, edible leaves, maize, horse gram, black gram, cowpeas, pigeon peas, several types of vegetables and variety of beans.

- Traditionally sowing period for the area lasted for four to five months, i.e., starting from May-October and farming lasted for 7-8 months starting from July to March climatic suitability. Tribal families sow millet seeds on hill slopes and paddy seeds on uplands. Vegetables and other crops are grown simultaneously.
- The farmers get vegetables from their farms everyday, whereas harvesting of millets and paddy carried out from October to February of the following year. Tribal families followed the practices of conserving traditional community seeds.

Leafy vegetables:	Dhimda, Dhimdi, Rajan, Lunkiya, Tamarind, cowpea, Poi, Methi, Palak, Dandi, Ambadi, olira
Green Vegetables:	Jhumka tori, Serial tori, Ghia-tori, Tindori, chichari, chibadi, Marela, Kihoda
Weeds:	Vanajua, Lunkiya, Puwar, Bokna
Fruits:	Timru, Ber, Jhad Ber, Khajur, Rayan, Imali, Mango, Ram-fal, Guava, Custard-apple, Jamun, Keekar, Banana, Papaya, bandar bati
Legumes:	Six varieties of semfali, Jalar, black-green gram, barbatti
Paddy:	Pathariya, Kali Kamod, Jira, bijali, local basmati, Dhimari, kolambo
Millets:	Bavta (Finger Millet), Kang (Fox-tail millet) Sama (little millets), Cheena (proso millet), Kodra (Kodo millet), Bajra (Pearl millet), Jowari (Sorghum)
Tubers:	Arabi, Ratalu, Garadu, Shakar-kand, Haldi (turmeric), Adu (Ginger), Ambahaldi (white-turmeric) Hakriyo (Sweet potato), suran, amarkanda, kandagola
Flowers:	Palash, Gulmohar, Mahua, Kachnar
Chicken:	Kadaknath, desi, buter, teetar
Nuts:	Bandar Bati, Ber
Grain:	Maize-sathi, Maize-Gangadi, Maize-pohata
Creeper:	Kanda Gola (Air Potato) barbatti

- Principal crops are maize and/or rice, depending on the type of land owned by a specific family. It takes care of the availability of different kinds of land owned by them, such as Talai land, terraced, and sloping land. Pigeon-pea, Jalar, Cowpea, fox-tail millet, and black-gram are grown as mixed crops.
- Normally maize is cultivated as a mixed crop, but rice is grown as monocropping in a particular field sometime rice and maize are inter cropped also.
- Growing over 20 varieties of crops was almost a standard for any single farm of a Bhil farmer. In his nearly four-acre farm, Amritlal Garasia, 50, a Bhil farmer from Mundari village of Anandpuri, grows over 30 varieties of crops including one upland paddy, finger millet, foxtail millet, sorghum, maize, edible leaves, black-gram, pigeon peas, cowpeas, varieties of beans and several types of vegetables. In tubers, he has grown Ratalu, Garadu, Arbi, kandagola, and sweet potato is commonly grown, some people also grow cassava in their homestead.
- "Our khet (as the Bhil name their farms) is influenced by the culture of the plants around us. It gives us everything, including the seeds for the next year, which we would be using throughout the year. In case any single crop fails, we have many more to survive on," Ranglal told. But, so far, I haven't seen any single year when any single crop grown by Bhil has failed.
- In order to grow so many crops in one khet, the sowing period extends up to three months from June till the end of August, based upon climatic suitability. Broadcast of the millet seeds on hill slopes during June month. At the time of arrival of monsoon, Simultaneously, vegetables and other crops as well. While leafy-vegetables and other local plants from the field available almost for six-seven months, and harvest paddy and millets after five months (October to February), Magsi Bhai, 58, of Peethapura village.

Photo 38 Various seeds and crops in a seed festival

Table 1 Indigenous Staple Food of Bhil Community

SL	Name of the food item	Genus	Species	English name	Season
1	Pathariya (75 days)	Oryza	Sativa	Rice varieties	Kharif
2	Kolamba (90-100 days)				Kharif
3	Kali Kamod (120 days)				Kharif
4	Dimari (Dhan)(90 days)				Kharif
5	Desi Basmati (105 days)				Kharif
6	Mal Kamod (75 days)				Kharif
7	Jeera (105 days				Kharif
8	Dhana har (90 days)				Kharif
9	Sathi-White(70 days)	Zea	Mays	*Makka* (Maize)	Kharif
10	Gangadi-Safad (90 days)				Kharif
11	Pohata - mix color(75days)				Kharif
12	Pili Makka				Kharif

13	Jwar -lal	Sorghum	aurdinacium	Sorghum	Kharif
14	Jwar-Safed	Sorghum	aurdinacium		Kharif
15	Kuri	Panicum	sumatrense	Little millet	Kharif
16	Kodra	Paspalum	scrobiculatum	Kodo millet	Kharif
17	Cheena	Panicum	miliacium	Porso millet	Multiple
18	Kang	Setaria	italica	Fox tail	Kharif
19	Bavta	Eleusine	Coracana	Finger millet	Multiple
20	Samali- small	Panicum	Miliare	Little millet	Kharif
21	Sama - Large Size			Little millet	Kharif
22	Gehu- Lokwan	Triticum	sativum	Wheat	Rabi
23	Gehu-Vajiya(un-irrigated)	Triticum	sativum	Wheat	Rabi
24	Jau	Hordeum	vulgar	Barley	Rabi
25	Jai (fodder)	Avena	sativa	Oats	Rabi
26	Tuar - lal	Cajanus	Cajan	Pigeon pea	Kharif
27	Tuar - Safed	Cajanus	Cajan	Pigeon pea	Kharif
28	Tuar - Gujarati	Cajanus	Cajan	Pigeon pea	Kharif
29	Jalar (Photo 35)			Field beans	Kharif
30	Chana -Kala Bada	Cicer	arietinum	Gram	Rabi
31	Chana - Chhota	Cicer	arietinum	Gram	Rabi
32	Urad - Kale	Vigna	Munga	Black gram	Kharif
33	Mung- Hara- Khotadiya	Vigna	Radiata	Green gram	Multiple
34	Mung- creeper	Vigna	Radiata	Green gram	Kharif
35	Mung- Kala	Vigna	Radiata	Green gram	Multiple
36	Masoor- Chhota	Lens	culinaris	Green gram	Rabi
37	Batli	Pisum	sativum	Pea	Rabi
38	matar	Pisum	sativum	Pea	Rabi
39	Barbatti	Vigna	Sesquipedalis	Cow-pea	Kharif
40	Safed Chavla	Vigna	unguiculata	Cow-pea	Kharif

Photo 39 Sorghum, in a field at kasarwadi, Kushalgarh

Table 2 Vegitables of Bhil Communities in the Study Area

SL NO	Name of the food item	Genus	Species	English name	Part consumed	Season
1	Kikoda	Momordica	dioicia		Fruit	Kharif
2	Valore	Dolichos	Lablab	beans	Fruit	Rabi
3	Jalar	Dolichos	Lablab	beans	Fruit	Rabi
4	Mooli phal			Radish	Root	Rabi
5	Barbatti	Vigna	Sesquipedalis	Cowpea	Fruit	Kharif
6	kandagola	Dioscorea	Bulbifera	Tubers	Tuber	Kharif
7	Ratalu	Dioscorea	Spp	Tubers	Tuber	Kharif
8	Garadu	Dioscorea	Spp	Tubers	Tuber	Kharif
9	Amar Kanda	Dioscorea	Bulbifera	Spring	Fruit	Kharif
10	Bandar Bati	Holoptelea	integrifolia	Nut	Fruit	Perennial
11	Safed-Kadu	Cucurbita	Maxima	Pumpkin	Fruit	Kharif
12	Bada Kaddu	Cucurbita	Maxima	Pumpkin	Fruit	Kharif
13	Lal batti	Cucurbita	Maxima	Pumpkin	Fruit	Kharif
14	Chir boti -	Solanum	nigrum	Makoi	Field	Kharif
15	Umbar	Ficus		figs	Fruit	Perennial
16	Ber	Zizyphus	Jujube	Zizyphus	Fruit	Perennial
17	Timru	Diospyros	melanoxylon	Fruit	Fruit	Perennial
18	Mahua	Madhuca	Latifolia	Mahua,	Fruit	Perennial
19	Karounda	Carissa	Carandas	fruit	Fruit	Perennial
20	Dori tel	Madhuca	latifolia	Mahua	seed-oil	Perennial
21	Mahua	Madhuca	latifolia	Alcohol	Mahua	Perennial
22	Alu	Solanum	tuberosum	Potato	Stem	Annual
23	Marela -	Momordica	dioicia	Bitter	Fruit	Kharif

24	Karela Long	Momordica	dioicia	gourd	Fruit	Kharif
25	Changeri	Oxalis	corniculata		Leaves	Annual
26	Til	Sesamum	indicum	Sesame	Grain	Kharif
27	Keekar	Pithecellobium	dulce	tamarind	Fruit	Spring
28	Amba Haldi	Curcuma	aambaa	Turmeric	Tuber	Kharif

7 Backyard Nutrition Crops of Bhil Families

Bhil farmers are famous for their linkages with nature; mostly tribal homestead is the treasure of food, fiber, fodder, and fruits. Table-2 shares about the 28 names of based plants items found around their back-yard. This rich culture is now collapsing due to market led farming practices, which are spreading among tribal communities also. Photo-37 shows various vegetables of the tribal community.

Jhumka Tori

Tindori

Kachari

Batti-Pumpkin

Tori (bulb)

Chery Tamatar

Okra

Valen Kakadi

Pumpkin

Photo 40 Commonly found vegetables around Bhil home and commons

8 Un-Cultivated Wild Foods of South Rajasthan

The food and farming system of the Bhil community in South Rajasthan also depends on many un-cultivated but collected food material. Some of these items which were abundant earlier are now reducing day by day and year-by-year. Table-2 shares names of things that are commonly found around in farms, homesteads, and commons. Most of these are un-cultivated and have multiple uses: medicine, food, fodder, manure, fuel, timber, handicraft, and fiber.

Bhil also collects many kinds of food from forests on the basis of their knowledge about the plants and tree diversity of forests. Our interaction with farmers indicated that these forests food plays a vital role in the supply of micro-nutrients, particularly in times of stress; they become a critical source of nutrition. Wild fruits make an essential contribution to the diet of the rural Bhil people in South Rajasthan and adjoining regions of Gujarat and Madhya-Pradesh. They also play a significant role in income and survival strategies for small and marginal farmers with marginal holdings, and landless families living near forest regions. Traditionally, they have been providing food supplements to these families, particularly during times of food shortage. Some of the wild fruits which provide income generation opportunities are, e.g., Mahua, Mango, Custard-apple, Jamun, Date, Anola, etc.

Mahua flowers, fruits, and leaves are edible and used as vegetables. The sweet, fleshy flowers are eaten fresh or dried, powdered and cooked with flour, used as a sweetener, or fermented to make alcohol. The fleshy outer coat of the fruit is used as a vegetable. Mahua seeds yield between 35 and 47% oil, which is used as a substitute for ghee. Mahua flowers are also used to produce some sweet preparations. The petals of Mahua flowers are collected and sun-dried; they are either ground to flour and used to make various kinds of bread or also fermented for produce local liquor, particularly during celebrations. It is inexpensive, and the production is mostly done in-home stills.

Bandar Bati (Monkey's Nut) is a nut, which is again part of tribal culture, but now known as children's time pass, (it seems as if children are wiser than adults. Its nuts are a little tricky to take out and need patience therefore, people instead prefer to leave this precious food, which monkeys know better.

The fruits are 1.5 to 2.5 inches in diameter, bright saffron-colored. Its leaves are also considered as good nutritive fodder, particularly for small ruminants. VAAGDHARA undertook a nutrition analysis of Timru fruits, which indicated that it is a rich source of Phosphorus, Sodium, Potassium, Calcium, Magnesium, Vitamin-A, and Vitamin C. Traditionally, it's leaves were used as food plates, unfortunately now those biodegradable healthy plates are replaced by biodegradable non plastic and paper plates. It has many medicinal uses as per Ayurveda like; seed for fighting an infestation of worms similarly, plash also in intestine and cream made of root oil as crack-cream. Other parts of the plant used in many diseases, i.e., diarrhea, dysentery, intestinal infections, diabetes, sore throat, and some skin disorders also. It's resin is collected as edible–gum and considered as one of the high nutritive ingredients for food preparation for women after delivery.

Table 3 Leafy Vegetables of Bhil Communities

SL	Name of the food item	Genus	Species	English name	Season
1	Channa leaves	Cicer	arietinum	Saag	Rabi
2	Chiel	Chenopodium	Album	Bathua	Rabi
3	Dhimda	Amaranthus	Viridis	Amaranth	Annual
4	Rajan	Corchoruo	Olitorus	Jute Saag	Annual
5	Imali flower	Tamarindus	indica	Tamarind	Perennial
6	Garmela (Mor)	Celosia	Argentia	Silver cocks	Kharif
7	Garmela (leaf)	Celosia	Argentia	Silver cocks	Kharif
8	Gunda (mor)	Cordia	dichotoma	Cordia	Perennial
9	Punwariya	Cassia	Tora	Cassia	Multiple
10	Bokna	Commelina	Dbescene		Kharif
11	Ambadi-Lal	Hibiscus	Cannabinus	Sorel	Kharif
12	Ambadi-Hara	Hibiscus	Cannabinus	Sorel	Kharif
13	Vanajua	Allium	Species	Wild Chives	Rabi
14	Kachnar	Bauhinia	verigata	Kachnar	Perennial
15	Tindorei ke dere	Trianthema	Monogyna		Annual
16	Chavle ke dere	Vigna	unguiculata	Cow-pea	Annual
17	Pyaj ke patte	Allium	Cepa	Onion	Annual
18	Lahsun ke patte	Allium	Sativum	Garlic	Rabi
19	Ghuiya Patte	Colocasia	Esculents	Touo	Kharif
20	Malan Bathua	Chenopodium	Gigateum	Bathua	Rabi
21	Karinjada	Celosia	Species		Annual
22	Sarso ka Saag	Brassica	juncea	Mustard	Rabi
23	Sahajan	Moringa	olifera	Drumstick	Rabi
24	Sathadi	trianthema	monogyna	Punarnava	Annual
25	Sathadi	Bauhinia	purpurea	Punarnava	Annual
26	Dhimdi	Amaranthus	gangeticus	Amaranth	Annual
27	Luniya	Portulaca	olerecea	Purselane	Annual
28	Sakar kand saag	Ipomea	reptans	Sweet potato	Kharif
29	Palak	Spinacia	oleracea	Spinach	Rabi
30	Methi	Trigonella	foenum	Fenugreek	Rabi
31	Muli Patta	Raphanus	Sativus	Radish pods	Rabi
32	Sarso	Brassica	Juncea	Mustard	Rabi

9 Goat Rearing within Farming System

Goat rearing is an essential component within the farming and livelihood system of the Bhil community. Every house keeps at least one-two goat; even if some home does not have a goat, with very first saving, they will try to get one. Sometimes if a family does not have one, then some relative will provide one kid so that they can get one and slowly-slowly starts rearing one and rejuvenate their farming system. Figure-05 shares about the role played by goat rearing among the livelihood of the Bhil community. Goat rearing provides scope for Bhil families to get benefits of commons in their village, as most of the goat fodder comes from plants and trees on commons. Some families do grow fodder plants in the form of agroforestry and farm-boundary.

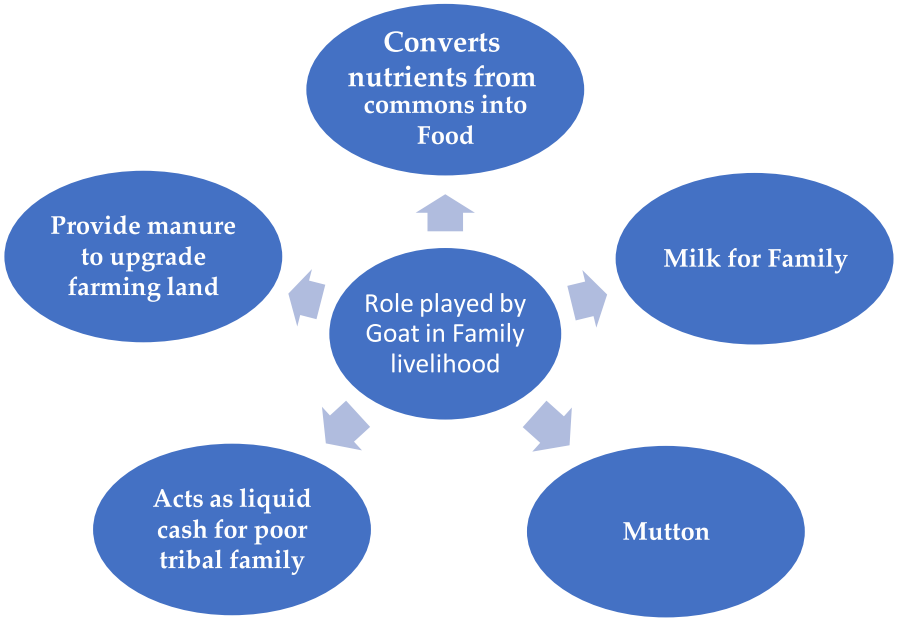

Figure 5 Role Played by Goat within a Farming System

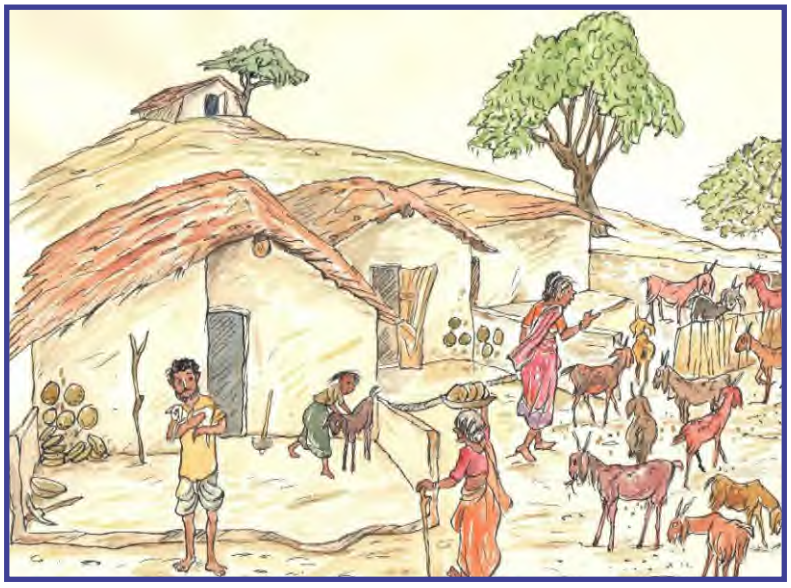

Photo 41 Goat Rearing withing Indigenous Farming System

10 Poultry - within Farming System

Within Bhil Farming System, Poultry birds are also important component; therefore, most families keep at last five-ten birds of local varieties called Desi. Even if some house does not have a bird, with very first saving, they will try to get. Sometimes if a family does not have one, then they will take egg or chicks from relatives so that they can get one and slowly-slowly starts rearing poultry and rejuvenate their farming system. The potential for quick sell makes their poultry birds as liquid cash, and it helps in fullfilling cash requirements of family.

- A good number of Bhil families now-a-day follows Kabir Panth, and do not consume poultry birds, but even then, they rear them to accomplish their role in the farming system but removing pests in crops, bugs, and ticks in dairy animals and goats.
- The mortality rate among the poultry birds of the Bhil community is as high as 60-70%, which is quite high. Most of it attributed to natural predators and the outbreak of diseases. Services towards poultry rearing are almost absent in the area.

Photo 42 Poultry within Indigenous Farming System

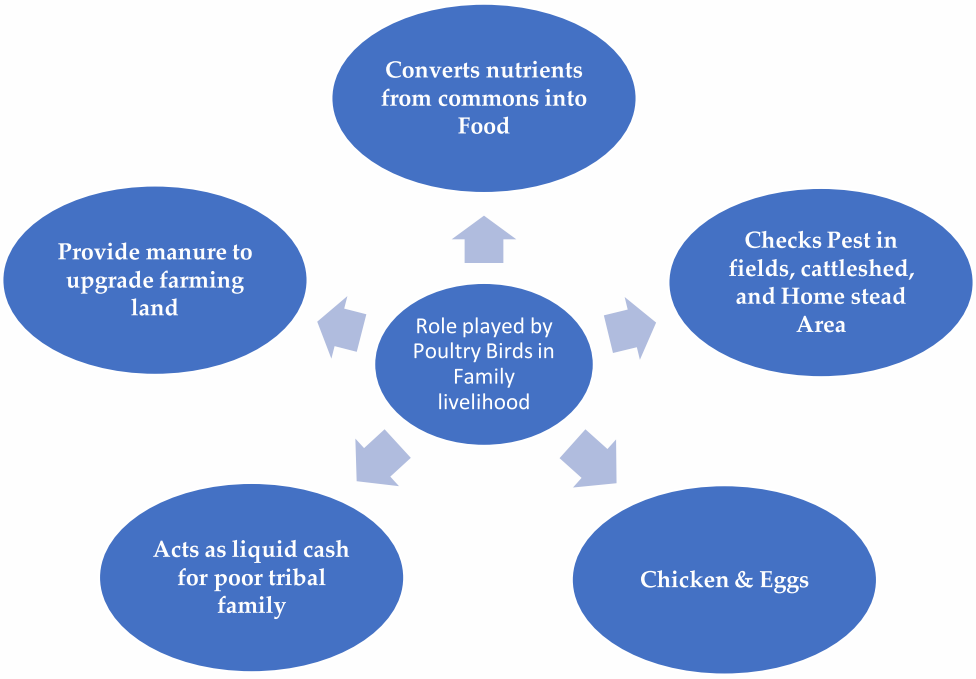

Figure 6 Role Played by Poultry Birds within a farming System

- Kadaknath is one of the famous poultry breed commonly reared by the Bhil community and it has black blood, full of iron and an excellent source to fight hemoglobin deficiency. Other local poultry breeds are also superior in quality.
- Bhil community keeps their poultry birds in a basket made of bamboo in the night, chicks are taken special care by creating some sorts of a small house, but not adequately designed.

11 Dairy - within Farming System

Traditionally, cattle rearing is not very common among the Bhil community. Mostly they keep one or two bullocks. Even today almost 80-90% of families have their bullocks, maybe one sometimes, but it is there. They are using it for ploughing and other farming works. Local cows in this region are called non-descript, they are short and tuned to a domestic geographical situation. Dairying for milk purposes is most uncommon, but nowadays, some families do rear cows and buffaloes for sale of milk and generate cash income.

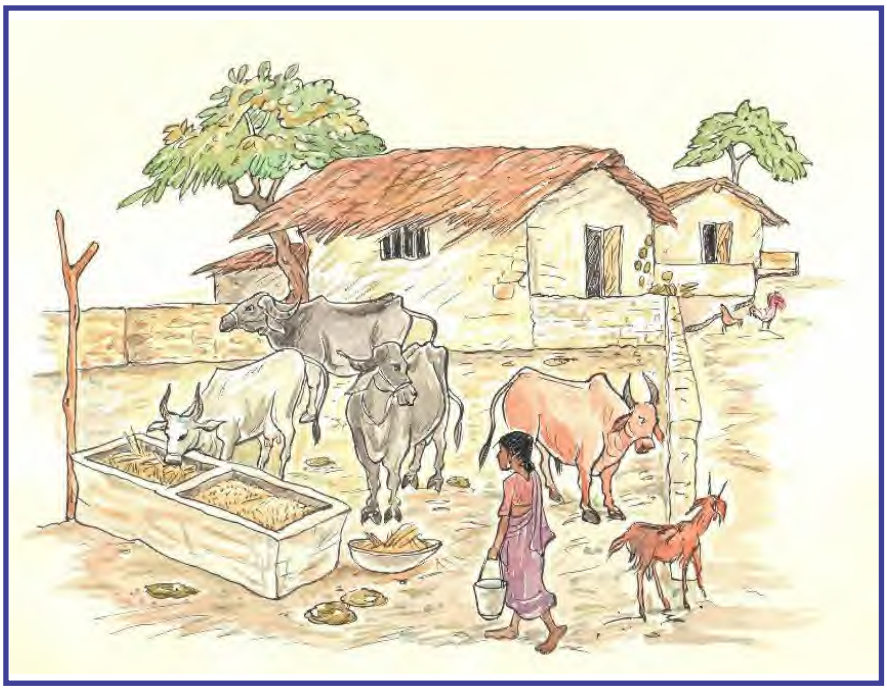

Photo 43 Cattle rearing in a tribal family

12 Harvesting, Threshing and Processing

The traditional farming practice of Bhil Community mainly followed low-cost methods of harvesting and threshing.

Photo 44 Drying of Wheat (Peepalkhunt)

Photo 45 Wheat drying form Thandla Area

Photo 46 Drying of Groundnut over Machan

Photo 47 Drying of Bengal-Gram

Photo 48 Dried and de-husked Bengal-gram

Most tribal families, whose fields are small in size do follow manual harvesting, sun-drying and bullock driven threshing (Photo-

Photo 49 Bullock driven threshing at Thandla

Photo 50 Dried Maize Cobs (Peepalkhunt)

Photo 51 Deeta Bhai, threshing his Maize

Harvesting of maize is done manually, first of all, cobs will be plucked and put on machan for drying, while stalk will be harvested and kept separately for fodder purpose. After two-three months, when cobs are adequately dried, and family has spare time, cobs will be de-skinned, and grains will be taken-out by biting through the wood plank.

Photo 52 Tool to extract edible oil of Mahua Seed, Peepalkhunt

Photo 53 Mahua Carnell at Ghata Village

Photo 54 Elderly Bhuri Bai with her organic turmeric

Photo 55 Dried Teemru, Fruits (Collected from Forest / Commons)

Photo 56 Drying leafy vegetable and other vegetables for summer montsh

The tribal region is part and partial of humid to a semi-arid agro-climatic conditions Consequently during the fall (winter) and dry period (summer), there are times when it is difficult to get food items particularly vegetables and pulses, which provides micronutrients and vitamins. At times due to more workloads, they get less time for cooking, thus they have developed recipes and processing to fulfill these requirements.

Drying and storing: To store abundant production of some items during monsoon months to fulfill the demand for green vegetables during summer months, traditional tribal families follow the approach, which is locally called Sukhamani (Drying). Common Sukhamani in the area is that of leafy vegetables are listed here.

Leafy Vegetables	Other vegetables
Chickpea, Rajan, Chiel bathua, Fenugreek, Dhimadi, Rati-bhindi,	Okra, Kachri, Semfali, Pumpkin, Tenda,

Photo 57 Drying of Kachari, as a vegetable for summer months

Photo 58 Dried Mango Flakes (Amchur)

Photo 59 Local Rope Product

13 Bhil Farming and Seed Management

Owing to forest degradation, fragmentation of holdings, erratic rainfall patterns, the area under cultivation has increased and diversity among crops has decreased, resulting in a decline in household agriculture diversity and loss of the indigenous varieties. Nearly a decade, most families started depending on market-based seeds, but tribal families follows their traditional systems of seed management. It is really fortunate that seeds of many local food items are still not commercialized; thus the Bhil community is able to maintain some of their traditional seeds. The following are common seed related practices. Seeds of Pumpkins, Cucumber, Valen-kakadi, Papaya, are mixed with cow-dung, treated with cow-urine and fixed on a wall or dried on leaves of large plants like Sagwan.

Photo 60 Storing seeds of Cucumber and Kadu Family

- Seeds of gourd plants like ridge-gourd, sponge-gourd, bottle-gourd, bitter-gourd and other local variants are kept in their fruit itself, which is dried on a creeper. The selection of the fruit for seed follows the preference of 1st fruit, 2nd fruit, 3rd frui, 4th fruit
- Similarly seeds of Okra, brinjal, kidney-beans, and groundnut are also kept within their shell or fruits.
- Seed for Maize is selected based on cobs from central parts of the field, right plants and best cob size with healthy grains. Cobs are plucked and hanged to avoid fungal infestation.

❖ In some villages, farmers keep their seeds by mixing with Neem-leaves and dung-ash filled in earthen-pot and sealed using cow-dung.

Photo 61 Storing seeds of the gourd family, Okra and Maize by Bhil Community

14 Bhil Farmers and Grain Storage

In recent years, post-production losses have become very critical. Studies have reflected that in India, post-production losses are as high as 50%. Traditionally, Bhil community was involved in the production of grains like Mal, Cheena, Kangani, Kodra and other minor millets; those have a much better shelf-life ranging from three to ten years. Bhil followed different approaches for the storage of grain and other food products such that they are available postseason to benefit the wider community. Given below are some collective reflection;

❖ Most common nonchemical management practices for storage, which are free of residual hazards are; Use of ash (Raakh) and castor (Arand) oil for storing the food grains for a long time to keep away storage pests. Use of cow-dung pasting on the cut surface or grazed away parts of fruit plants as an anti-inflammatory and repairing agent is an age-old practice.

Photo 62 Various Traditional Storage Dins

- Cobs of Maize harvested from the field will be piled-up in the threshing ground or on the floor of the house, which is cleaned and washed with cow-dung. Once dried, they will be stored in large drums made of bamboo sticks, pasted with cattle-dung, and closed. Some families do keep neem-leaves with it.
- Sesame is initially cut and brought from the farm and kept in standing position for around 15-20 days once dried grains are taken-out and kept in earthen-pots.
- Ground-nut is mostly kept with cover to avoid stinking with oil.
- Use of ash (wood or cow-dung cake) or mixing grains with dried Neem leaves works as repellent /antecedents for storage pests to protect wheat and pulses.
- Putting Turmeric in both powder and raw form (Curcuma longa- both rhizome as well as powder) or robust and pungent Ajwain or clove (Syzygiumaromaticum) acts as a repellent for storage pests.
- Smearing the grains with castor (Arand) oil or mustard oil is known to bring about freedom from the pests, particularly for wheat, rice, pulses etc.
- Some tuber crops like Ginger (Adarak),Arvi (Closom),Ratalu/Garadu can be stored for a longer time in moist soils for prolonged shelf life using mulching life.
- Drying of food grains like wheat, maize in hot Sun during April-may months kills the pathogens/pest remains on grains.
- Chana chaukar mixed with sand in equal quantity controls ghuna
- Lahsunki do ganth in 5 Kg rice controls Ghuna, Chintiaurtilchatta.

- ❖ Wood ash and dried neem leaves control Ghuna.
- ❖ Garlic (Lahsun) stored in earthen pots along with ash or hanging plant in dry shed room has proved to be the best way to prevent post-harvest losses
- ❖ Winnowing, the lighter and pest infected seeds using 'Sup' is a common practice to get rid of pests/pathogens.

15 Bhil Weather Science

Bhil has a system for rainfall prediction, according to which they alter the timing and composition of their crops. In Bhil cultivation, sowing has to be done just before the first gentle showers of early monsoon. This makes accurate predictions of these first showers crucial.

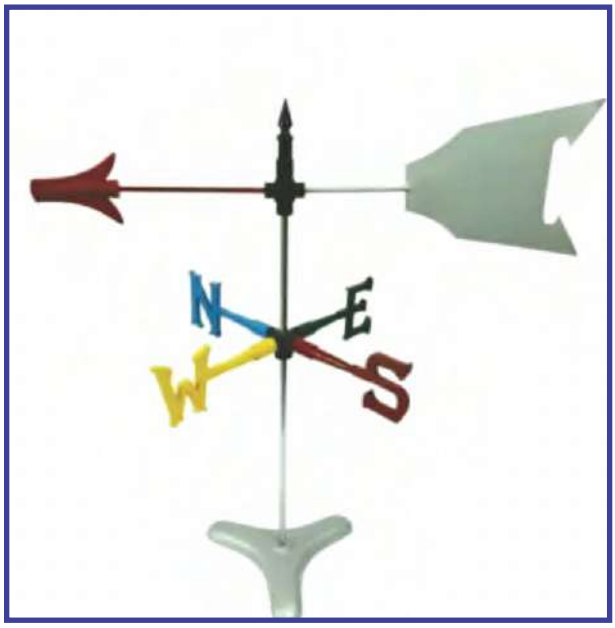

Photo 63 Wind Weather Detector

- ❖ Bhil used to follow rain prediction with the help of a local tuber known as Kandagola. "The tuber is planted in Badi (vegetable garden) in summer, and coming out of its first shoot, through the ground, indicates that rains will follow within a week or ten days. Thus, this time period is used to prepare for sowing."
- ❖ Peepul tree is also considered to predict first rain. They believe when the tree has shed all its old leaves and the process of new leaves sprout completed, precipitation will take two to three weeks. These signals usually gives a sufficient accurate estimate.
- ❖ Place of laying of eggs by bird locally called Titahari (Titori) also used as an indicator of the quantity of rainfall. When it lays eggs on some tree, it is considered that rains will be substantial, causing some floods; thus, eggs are laid in higher elevation. But it lays eggs near to ground; it is regarded as that year may be a drought year.
- ❖ A tiny insect ghunghuti appears in open spaces, indicates possibilities of massive rainfall year, and Bhil plans for more kutki, which isa highly water demanding crop."

16 Expression from different stakeholders on Bhil Farming System

The Bhil farmers don't need to do anything for pest control. All they do is raise the farm to provide food for ten families (dusparivar), including that of the grower, pests, insects, ants, flies, spiders, and birds. As the crops grow, pests and insects come. The ants, flies, and spiders eat them. Birds, searching for food, also come to the field to feedon flies and insects. "Bhil can live without wheat, but without maize,they will be starving," says Jayesh Joshi.

Manji Bhai of village Phithapura says that we do not have much traditional knowledge of weather prediction, but our forefathers have arrived at a crop-mix that works in all rainfall conditions. Bhil follows mixed cultivation of eight to ten varieties of millets, corn, and five types of legumes together in a single field. "We plant about 50 percent Makka, and the remaining 50% make up of various other crops Kaang, Jalar, Chibda, Barbatti. He says with a change in rainfall, the yields of individual crops rise and fall, but the overall system yield remains stable."

B.M. Dixit, of VAAGDHARA, indicated that the traditional food security system provided a very diverse and balanced mix of nutrients in the form of several millets, legumes, cereals, fruits, vegetables, and herbs. The food security proposed by the state should support this strength and self-reliance on traditional food systems instead of harming them. Therefore, it is crucial for the government to have a better recognition of the inherent power of Bhil agriculture. The effort should be to build further on these strengths instead of thoughtlessly uprooting traditional wisdom.

Mr. Warsing Bhai, Raipuriya, Ratlam, M.P. says that earlier most but now few farmers cultivate their fields in a traditional manner absolutely with no-cash expenditure incurred in their farming. They save seeds from the previous crops, trees and animals fertilize the fields with crop residue and manure, utterly free from chemical poisons, provides nutritious food for bullocks, cows and other farm animals. Mixed farming of grains and legumes ensures that soil fertility is maintained. If one crop fails due to some reason, other produce of the mixed farming system enables farmers to survive despite some loss. The farming system of the Bhil community works because they don't use any kind of chemical fertilizer or pesticide. Instead, they allow pests and insects and their predators (a hen) to roam in the field freely. Therefore, traditional and sustainable agriculture by Bhil communities is more or less sustainable and climate-smart. "The natural system in Bhil villages work because only in villages where they don't use any kind of chemical fertilizer or pesticide. Rather, they allow pests and insects and their predators to move around the houses freely," said Jayesh Joshi of VAAGDHARA, Jayesh Joshi, says: "We found that several Bhil farmers were routinely growing 55 to 60 crops, and the mixed farming system was rooted in sound agronomic and nutrition logic. They had excellent knowledge of diverse uncultivated food they could obtain from forests and commons. While Bhil looked upon their land as mother, outsiders looked only at the production they could extract as quickly as possible. There is a fundamental difference between the two and adapt the logical Bhil farming system.

17 Sustainable Integrated Farming System : The Premise of Climate-Smart Agriculture

Though indigenous practices of Bhil farming systems were climate-smart, due to market led interventions and changes in farming practice,a more significant number of families are now started facing instability in livelihoods. Our interaction with community leaders has helped us to come out with some common points which can be useful for building on existing farming system and further making it climate-smart farming.

- Many a time crops failed in large parts of Southern parts of Rajasthan, and Western parts of Madhya-Pradesh, due to pest attacks, prolonged periods of dryness and untimely rainfall, farmers among the Bhil tribe in these regions brought home a better harvest, primarily due to their traditional practice of diverse cropping to safeguard against nature's vagaries.
- In mixed farming, various crops support each other, the growth of maize protects black-gram and cowpea, and Jalar from strong winds. Legume crops make up for the nitrogen taken up by cereals.
- Bhil farmers are reviving multiple crops on their small fields of two to five-acre farms and the mixed farming system was rooted in sound agronomic and nutrition logic.
- There is a need to undertake action research and back-support traditional knowledge about very diverse food they could obtain from forests.
- Bhil farmers have proved that agriculture is not just about the yield or producing more. It is about cultivating a crop without harming nature, soil, and ecosystem. It is about creating food opportunities for many other co-existing species and contributing to universal peace and natural harmony.

- The traditional agrarian practice of these Bhil farmers proves to be a system that can be followed by the world for sustainable and organic farming to achieve global nutrition and food security in the era of climate change.
- For Bhil farmers, agriculture is not just about the yield or producing more, but growing food without harming nature, the soil, and the ecosystem, while creating food opportunities for many other co-existing species. when the world advocates for sustainable and organic farming to achieve global food and nutritional security in the wake of climate change, the traditional agrarian practice by these Bhil farmers make it a case of success.

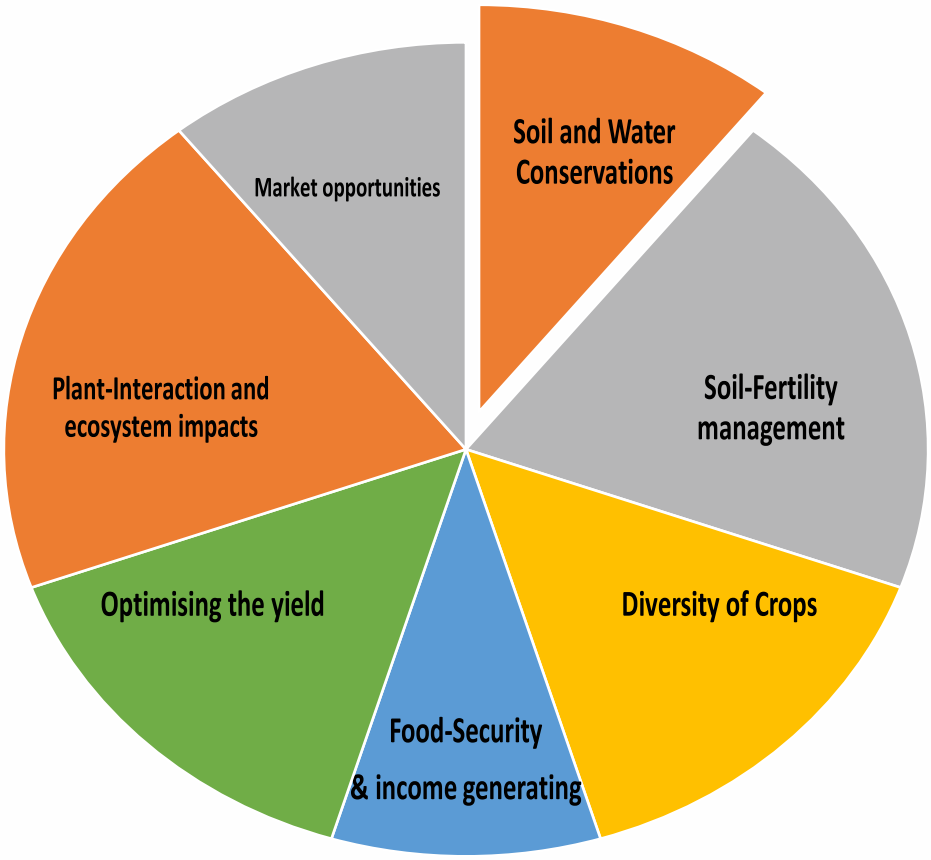

Figure 7 Potential aspects of climate change adaptability

- Unfortunately, the spread of monoculture crops and plantations under the name of 'development' as well as other destructive projects implemented thoughtlessly without understanding the value of Bhil farming harmed the self-reliance of Bhil communities.
- Experiences of VAAGDHARA, Shows that modern food security protocols planned and proposed by the government should take into consideration the ability of traditional farming systems, particularly of Bhil community to provide a very diverse and balanced mix of nutrients in the form of several millets, legumes, cereals, fruits, leaves, vegetables, and herbs. The food security proposed by the state should support this strength and self-reliance on traditional food systems instead of harming them.
- Almost unaware of the scientific debate and discussion over climate change and its impact, the traditional agrarian practice of these Bhil communities has evolved in harmony with nature having climate resilience integrated with it naturally. Even the conventional upland paddy varieties like Pathariya they use are less water consuming, so they are resilient to drought-like conditions, and are harvested between 60 and 90 days of sowing. As a result, the possibility of complete failure of a staple food crop like millets and upland paddy grown in a different field is very low even in drought-like conditions.

- Their fields can also survive extreme and untimely rain because of the traditional cropping pattern the Bhil farmers follow. "Rainwater do not flow at full speed to wash away the plants and damage the crop," Ruplal 40, of Gamana - Hameera village. The speed of rainwater flowing down the hill slope is broken by the thick shrubby black gram cowpea and groundnut plants to protect the millet and other crops.
- Bhil farmers can apply the approach of a circular economy to their farming system to identify weak links and strengthen it to address issues of climate change-induced weather variabilities.
- Faced with erratic rainfall and extreme weather, Bhil farmers of the area follows mixed and relaid forms of cultivation. This cultivation is much more resilient to environmental stress and gives an assured yield in both low and excess rainfall conditions. State Climate Action Plans for all the three states, for instance, calls for policies to manage climate risks for sustainable productivity; the states also have millet cultivation project. Government agency should take steps to study or protect low-risk cultivation practices that have the potential to meet the food security needs of large Bhil populations. This year, heavy spells of rains and a prolonged monsoon have caused crop damage across the country but a visit to the agriculture plots of the Bhils in MP shows all signs of a bumper crop harvest. "This was an excellent year for the production of Chibda (BalenKakari) and kutki (little millet). In recent years, there have been repeated instances of monsoons starting late with sudden heavy showers; many villages lost their seeds and seed management systems.
- Under their mixed farming system, seeds of several kinds of cereal, millets and legumes are sown together at the same time in or around June. Their traditional farming system had no cash expenditure. They used to keep seeds from the previous year's crops. Farm animals fertilize the fields with manure while the crop residues of this organic mixed farming system, completely free from chemical poisons, provide nutritious food for bullocks, cows, other farm animals, and family members.

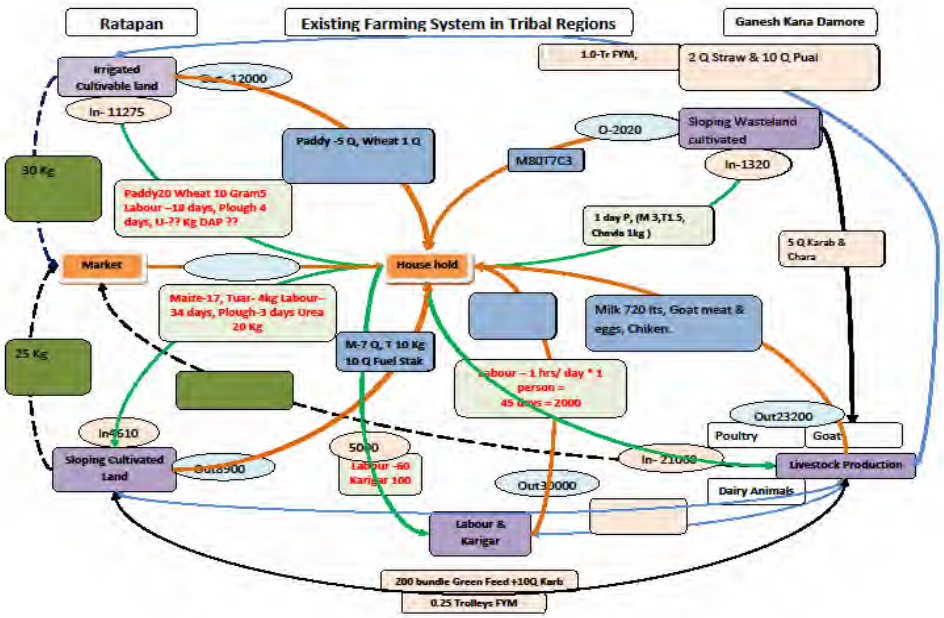

Figure 8 Circular approach in Bhil Farming System

At last, we can conclude that the Bhils obtain their food through agriculture and gathering. Most of the bhil families harvest different dryfood for lien periods like summer, winter, and for emergencies like crop failure. Traditional Bhil foods include Maize, squash, beans, onions, pumpkins, sesame, mango, mahua, air-potato, Wild greens, and monkey's nut. This circulation within farming can pride answer to many question on sustainability of agriculture.

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