VAAGDHARA

Banswara(Raj)

(VOLUNTARY ASSOCIATION OF AGRICULTURE GENERAL DEVELOPMENT, HEALTH AND RECONSTRUCTION ALLIANCE)

Community Practices For Food Security




Preface

VAAGDHARA, is an NGO dedicated to the cause of food security for poor tribal community in the remote hilly villages of Banswara and other adjoining districts of south Rajasthan. It seeks to work with indigenous community for evolving sustainable farming systems that can help them to develop resilience against changing climatic scenario. This will require blending of Indigenous and Scientific knowledge and to influence policy formulation to create conducive environment as its mission. This is in line with the Gandhi ji's dream of **GRAM SWARAJ.**

In this endeavour VAAGDHARA, approached Dr. H. K. Joshi, Scientist,(Plant Pathology) ICAR, the main contributors of this paper who has tried to reaffirm that there is enough scope to achieve management of 'Pests' by adopting Community practices. This attempt tries to analyse and highlight that transition process from conventional to more sustainable agriculture does not necessarily mean that every thing should be reversed. Similarly, modern technology and inputs need not be discarded at once but blend of practices and systems shall enable us to combat the emerging challenges in agriculture.

We are glad that this publication have focus areas common to recommendations of "National Commission on farmers" to rejuvenate our agriculture system not only for increasing agricultural production but also optimising and sustaining production systems for ensuring food security. It also includes aspects to preserve and strengthens our natural resources base in view of the inevitable situation emerging out of the climate change.

Hope this publication will help various stakeholders involved in developing sustainable life and livelihood for communities in different regions.

Jayesh Joshi

Secretary

Contents

Background

In India, Agricultural Sector has always been the backbone of economy and is likely to remain so for the times to come. About 69% of our population is dependent on Agriculture and it contributes to GDP to the extent of 19%, which is much higher than China (Only 14%) and U.S.A. (1.5 to 2%).

India is a vast country and has a long history of severe famines such as the infamous Bengal Famine-1942-43;and the famine that occurred in entire north India-1965-66, 1971-72 & 2001-02. Rajasthan, Maharashtra & Andhra Pradesh have regularly been facing recurrent famine conditions over centuries partially or fully. India could face these severe droughts comfortably due to technological advancements resulting in buffer stocks. These technological advancements could be achieved due to foresight of the first Prime Minister Pt. Jawahar Lal Nehru, who remarked in 1948 that "**Everything can wait but not agriculture**". Consequently the technology break-through in production technology and subsequent follow-up by farmers resulted in green revolution in Wheat, Rice and Oilseeds, which encouraged farmers to adopt new technologies. The entire 'Green Revolution' programme included three basic elements; Introduction of high yielding varieties of Wheat and rice (i.e. improved seed); Adoption of intensive cultivation practices with the help of extension network and Extensive use of irrigation, fertilizes and agro - chemicals.

New agro-techniques were developed, irrigation facilities were created, economic status of farmers was improved by liberalisation of credit and banking policies, lab to land programmes as also other follow-up extension programmes were initiated by ICAR and the state governments. All these measures have almost tripled our agricultural production. However, since then, once again our population has doubled and the arable land of about 145 million hectare is static, rather decreasing on account of population pressure, inhabitation, SEZ and industrialization. Out of this 145 million hectare, 45 million hectare is irrigated and responsible for producing around 55% of the food out put. About 50% of the irrigated area is served by ground water sources. Most small and marginal farmers live in rain fed areas and produce hardy crops like millets, pulses and oil seeds. The ongoing farming practices of rain deficit areas may not be profitable in economic terms but definitely profitable in ecological terms and play effective role in providing food and fuel wood security to a larger population.

We have been successful in increasing our food production through first Green Revolution and subsequent efforts made in this direction. We have also achieved considerable success in increased food supply to farflung rural areas but we have achieved only marginal success towards **reducing under nourishment**, unger and indebtedness. Following issues need to be discussed:

Increased population, greed, industrialisation, etc caused encroachment or grabbing of the commons, forestlands, grasslands, wetlands, pastures, submergence and catchments area.

Agricultural farms have become mono cropped and soils have been eroded, exhausted or becoming non-cultivable.

Researchs, trials and studies are limited to a few crops particularly high external input reliant crops.

In researches and trials, indigenous practices have been ignored and are often considered backward or non-productive.

Agriculture innovations in crops have focussed productivity instead of farming systems, and they are not designed to take advantage of local climate, bio-diversity and ecology.

The approach of intensive farming using modern technologies in agricultural production has caused some negative effects on environment particularly declining biodiversity (Flora and Fauna). However, neglect has reflected into over exploitation of resources in various districts covered under green revolution.

Above factors had adverse effect on cost benefit ratio of agriculture, energy efficiency, natural resources and ecosystem, etc. Investment needs to be driven to make agriculture more remunerative, maintain productivity despite soil degradation and climate variations.

In view of these facts we have to analyze **indigenous agricultural and allied practices** vis-a vis use **of technological developments** for food security. In view of these, the Prime Minister Dr. Manmohan Singh strongly advocated the need for **second Green Revolution** during his address to the 93rd Indian Science Congress in January, 2008. He stated that "The technology and strategies unleashed by the first revolution have run the course" He emphasised that the Second Green Revolution is needed with special focus on **dry land agriculture and marginal farmers** with special emphasis on solar energy, Biomass and appropriate animal husbandry targeted at poor. He endorsed; Soil health enhancement; Water harvesting; Water conservation and equitable use of water; Affordable Credit and Life insurance and component of **Sustainable farming** which promotes ecological balance. Once again; we are forced to think about our traditional technologies, which amply take into account the first three points related with food security and ecology. The indigenous practices ensured ecological friendly cultivation and preservation of environment.

Climate change and food security

Food security is the ability of a community to command food, generally acquired through the net result of its livelihood activities. It is not only their command on food produced by them but also purchased from their non farm activity incomes or any other source. Dynamic interactions between and within the bio-geophysical and human environments lead to the production, processing, distribution, preparation and consumption of food resulting in a food system that underpin food security. Climate variability affect food

systems in several ways ranging from direct effects on food production (e.g. change in rainfall leading to drought or flooding or warmer or cooler temperatures leading to change in length of growing season or change in cropping pattern, selection of plant species and so on) to changes in markets, food prices, supply seasons and regions. These changes encompass:

1. Food availability (Production & Distribution)
2. Food access (Affordability, Allocation and Preference)
3. Food utilisation (Nutritional value, Social value & Food safety)

Therefore food security concern incorporates both biophysical aspects of crop production and socio-economic aspect of food system to address key questions of:

Which aspects of food system are most vulnerable to climate change?
How to reduce vulnerability of these food systems and improve food security?

There cannot be a single solution to address the vulnerability of food systems. For different situations different solutions shall be applicable. However Adaptation is the keyword for reducing the vulnerability of food system that is access to food and the food security. However, following three concerns come to focus:

1. Increase food production.
2. Improve food distribution system.
3. Increase economic access to food.

In attempting to adopt food system to cope with climate change, it is necessary to provide land cover and plantation to mitigate the problem of emission of carbon dioxide and leave intact the existing forests and a ban on tree cutting. The other solution could be adoption of farming practices and systems that encourage greater input efficiency to minimise environmental consequences. Adoption of indigenous agricultural practices which are eco friendly need to be extensively adopted to maintain not only the high level of production but also to improve and strengthen available natural resources at our disposal.

Core-issues in Sustainable Farming

Within the purview of Sustainable Farming the key issues are food security, climate change and indigenous knowledge.

Food Security: Exists when all people, at all times have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (World Food Summit, 1996). **Thus easy availability, preferable and palatable food to all people gives food security.**

> Farmers cannot be considered as passive consumer of agricultural technology but also active problem solvers, who infact adopted or developed most of the technology they use; to the best of their ability, available resources and also their past experience.

Climate change: Means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time period. Above definition was adopted by UN Framework Convention on Climate Change.

Indigenous Knowledge (IK): Is the local knowledge that is unique to given culture or society. Indigenous knowledge contrasts with the international knowledge system generated by universities, research institutions and private firms. It is the basis for local level decision making in agriculture health care, food preparations, education, natural resources management and a host of other activities in rural communities.

> The word 'Sustainable Agriculture' refers to continued efforts to remain active or productive while maintaining resource base. Sustainable agriculture is successful management of resources for agriculture to satisfy changing human needs while maintaining or enhancing the quality of environment and conserving natural resources. It is an approach, which is ecologically sound, economically viable, socially just, humane and adoptable.

India harbours about 75% potential biological species of the world. It's cultural and ethnic diversity with 550 tribal communities of 227 ethnic groups spread over 50000 ethnic villages follow various agricultural and other practices. These practices have been evolved and established through generations. Many of these practices are practical, pragmatic and better adopted to specific conditions over several modern technologies. They may prove more eco-friendly, sustainable and counteracting to adverse climate changes and result into sustainable agriculture.

Sustainable Agriculture is one of the most critical issues of our time. Intensive use of hybrid crops and indiscriminate application of chemical fertilizers, pesticides, fungicides, herbicides and over irrigation resulted into land degradation, loss of soil fertility, accumulation of salt on the earth crust, loss of bio diversity and pollution of land which account for increasing damage to ecological foundation of agriculture. Higher dependence on external inputs and expertise robbed people of inherent competence and local enterprises. More than 70% farmers are small or marginal, semi-educated, poor and not having access to required resources of modern times. Therefore, Indian agriculture is also poised to some highly contrasting challenges. It is, therefore, appropriate that for optimum benefits following facts should be given importance:

1. Recognising – IK and communities practicing them.
2. Validation of IK and technological advancement in the local conditions.
3. Proper understanding of local resources, plants and physical resources.
4. Blending of IK and modern technology by farmer focused trials and experience.

The present day Agriculture have seen many technological innovation including Genetic Manipulation (BT-Cotton, BT-Tomato, BT-Eggplant, BT-Maize etc.); Precision Farming

(Computerised agriculture); Protected Agriculture (Poly house/Green house/Glass house); Micro - Irrigation (Drip irrigation); ICT (information communication technology) in agriculture; biotechnology (Bio-fertilizer, PGPR, tissue culture, bio-pesticides, vermicompost, compost making, etc.): high yielding varieties (HYV) etc. There are a number of practices which were developed by generations although not have technological validation but have proved their worth from time to time. More and more importance has been recognised for bio-diversity conservation, natural resources management, ecological farming and Low External Input Sustainable Agriculture- (LEISA) etc.

Indigenous agricultural and allied practices

The book "The history of Indian Agriculture" by Prof. M.S. Randhawa, reflects the worth of traditional knowledge of farmer of Rajasthan as the most intelligent, clever and skilful in whole world. The book refers their expertise of optimising production of traditional crops under scarce water availability following different rainfed farming conditions. One of the important components of this traditional wisdom has come through women. Dr. M.S. Swaminathan observed that perhaps the oldest agricultural scientists were the women playing their role as housewife. The whole traditional system of value addition and storage of agricultural produce was evolved by the women only. The traditional practices of seasonal agricultural operations were related to selection of seeds of some species and varieties for growing, type and length of crop rotations, tillage and residue management, planting date and depth, frequency of irrigation, use of manure, harvesting time etc. **There are large numbers of agricultural practices which are dying year by year in our countryside farms, while our agriculture systems are also facing threat of instability. Given below are some of the traditional practices which have potential for making agriculture more sustainable if understood properly and blended appropriate with modern scientific knowledge by involving farmer's as scientists.** Now it has become imperative to look into the economic and socio-economic aspects of large number of small and marginal farmers and Indigenous Technical knowledge and practices should be adopted for betterment.

All agricultural practices commence for forth coming *Khariff* start on *Akshay Tratiya* (3rd day of *Jyeshtha*-May). This favours preparation for and gathering of all paraphernalia and it also reflects that practice of deep ploughing during hot summer kills remains of pests and diseases, especially the soil borne pathogens.

Practices for reducing storage losses

NCIPM (National Centre for Integrated Pest Management) has tested worth of many traditional non-chemical management practices which are free of residual hazards. Some most common ones are; Use of ash (Raakh) and castor (Arand) oil for storing the food grains for long time to keep away storage pests, use of cow-dung pasting on the cut surface or grazed away parts of fruit plants as anti-inflammatory and repairing agent is age old practice.

Use of **ash (wood or cow-dung cake)** or mixing grains with **dried Neem leaves** works as repellent /antifedents for storage pest to protect wheat and pulses.

Putting **Turmeric in both powder and raw form** (*Curcuma longa*- both rhizome as well as powder) or strong pungent Ajwain or clove (*Syzygium aromaticum*) acts as 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.

Smearing grains with Turmeric powder (Haldi) and Oil helps in preventing storage losses.

Some tuber crops like Ginger (Adarak); Arvi (Closom); Ratalu/Garadu can be stored for 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 chhan kar mixed with sand in equal quantity controls ***ghuna***

Lahsun ki do ganth in 5 Kg rice controls *Ghuna, Chinti aur tilchatta.*

Lakri ki Rakh (Wood ash) and *sukhi neem patti* (dried neem leaves) controls ***Ghuna.***

Garlic bulbs (Lahsun) stored in earthen pots along with ash or hanging whole 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.

Practices to control pest on plants

Normally three types of pest attacks the crops namely soil pest, sap sucking pest and leaf cutter pest. Sucking insects sucks the plant sap and weakens the plant and facilitate infection of virul diseases like mosaic, *matha bandhan* etc. Common among them are *Chempa* (Moila), *Hara tela*, *Safed makhi*, Thrips, *Makri*. This group of indigenous practices talks about the methods to control different insects/pests affecting common crops in the Mewar-Vagar-Malwa region

Safed Makhi and *Chempa* are attracted by yellow colour, thus hanging grease/burnt oil plastered yellow card in field control white fly, as it attracts white fly, which get stick to card. Once card is full of fly collect and destroy them.

10-15 days old *Khatta Chhachh* (Butter milk) 100-150 ml mixed with 15 litre water, spray on *Chana, Tuar* reduces effects of **sucking pests like sundia (illi) and** reduces incidence of **vector borne viral diseases** and some fungal diseases.

To fight infestation of aphid/white fly spray of 4-5 % neem oil (*Nimboli sat*) every 10 to 15 days.

50 kg *Nimboli powder, 2.5 kg Tambaku powder and 40 litres gaumutra soaked overnight and mixed with 400 litres of water to spray in one hectare area.*

Plantation of Hazari (Gull Gatta) flower along the farm bund or water channels help in controlling many pests/nematodes based problems. In larger fields it can be used as 10 lines of crop followed by 1 line of Hazari (Marigold). In vegetables one line of marigold for every 16 lines will be useful.

Sprinkling of ash (50-60 kg/ha) on aphid infested vines of cucurbit, beans or maize and various other diseases like white rust, downy mildew & powdery mildew in mustard crop

Ash (2-3 kg) mixed with castor Oil (750 gm) is spread to control damping off disease in cotton nursery (0.01 ha)

A spoonful of Hing (Asafoetida) powder put in fine cloth and tide around the lower rotted portion of bottle guard vine for treatment of root rot/collar rot.

Sowing of Daincha (*Sesbania sesban*) (green manure crop) along paddy field boundaries is considered better alternative than using Melathion dust. Application of Neem cake and spray/ of Neem seed kernel extracted @500 g. In 10 lt.water has also yielded positive results in pest control. The powdered NSKE is pre-soaked in water and mixed with 10 lt water, then sieved and sprayed on crops.

In Western Rajasthan, bio-pesticides preparation by mixing cattle urine with Neem, Dhatura and Aak (calotropis) leaves and allowing it to ferment for 15 days, filter and dilute it to 10 times and spraying on plants result to check pest population and enhance plant growth.

Use of leaves of (Aak) *Calotropis procera* for termite and nematode control has been very effective and is proven indigenous method.

10 litre ***Chhachh*** 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 *chana ki illi.*

In Malwa region some people use Lahsun as effective pest control by preparing a ***chatni*** (paste) of 2.5 Kg lahsun mix it well with 500 litre water filter it well using thick cloth. Spray filtered solution on ***illi*** infested crops at the time of sun set. ***Illi*** will be either killed or get in-activated.

Some people take a mix of 5 litre Gomutra, 1 kg Sitaphal Patti, 150 grams Tambaku churna and 100 grms Lahsun, worm it in copper pot and filter it. 100 ml of solution mixed with 10 litre water and spray to control insects.

To prevent infestation by broom rape (Orobanche Cenua) on the roots of Brinjal, Tomato or Sarson, the flowering shoots of broom-rape are cut before seed set and a drop of kerosene is put on cut end. Secondly in the next season, the area should be planted with Cowpea (Chouli) or Chilli (Mircha). This prevents infested with broom rape spread of O. Cernua.

Usually farmers are aware that kerosene oil keeps away snakes and even kills some type of snakes. Now it has been experienced by farmers that kerosene could also kill brown plant hoppers. Spraying of keresine oil emulsion 10% on the crop using 10 g soap/lt of water prevents this pests attack.

The farmers are adopting the indigenous technology using five litres of kerosene oil mixed with 25 kg of paddy husk to treat 0.25 hectare of reclaimed land.

Practices related to viral and fungal diseases

The phyllody of *til* is most destructive disease of this crop and reduces yield by 30-50 percent. Intercropping with maize is a practice in Gujarat. Growing til (4 lines) between 2 lines of Maize reduces the incidence of phyllody disease in til.

Custard apple (*Sitaphal*) have 3-Quamosin-2 chemical, which is harmful for insects. It can be successfully used to control *illi in cotton, tamatar, mirch, bhindi, gram, jwar etc. It can be used by preparing Ark of 2 Kg of Sitaphal seed powder, mixing it with 200 litres/ acre*

There are number of plants, which can be used as pest repellents such as Vasaka, Aristolochia, Ginger, Dathura, Calotropis, Nuxvomica, Dalmation Pyrethrim, Jatropha, Custard Apple, Aloevera, Holy Basil, Marigold, Bitterguard, wild Almond, Flame of Forest, Garlic, Pongamia, Lucky Nut, Turmeric, Acorns, Dhudi, Fenugreek, Neem, Vitex-negundo and Lantana.

Spray of 10 % cow milk reduces intensity of **powdery mildew disease** on several crops like ber,okra, cowpea and cluster bean.

Jaipur farmers dust the ash (50-60 kg per hectare) on the growing crop of *Rajka* (lucerne) (*Medicago-sativa*) to check the growth of doddar (*Cuscuta* sp). Farmers also use mixture of ash & common salt for better results.

Spray of 10-25% cow milk imparts resistance to viral diseases in plants. It has been found reducing incidence of disease like Ber-powdery mildew, papya singspot virus, bud necrosis of peanut and water melon and TSWV of tomato and chilli.

Treatment of ***chana beej by*** soaking it in ***chhachh*** for 4 hours helps in controlling "***ukatha rog***" fuse wilt.

In Pali & Barmer districts of Rajasthan, people apply "ten days old pearl millet flour and ash mixed 1:4 for cumin (Jeera) crop" before flowering to prevent infection of powdery mildew. This can be also be applied on Rose crop.

Burning of 9" thick pile of trash on the site of nursery kills pythium and other pathogens which cause damping off and other diseases. This much pile on burning produces heat that may kill inoculums of *Pythium, Rhizoctonia* and pests like termite and pupae of borers.

In Jodhpur and Sirohi Districts, FYM is applied @ 10-15 tonnes/ha in chilli fields to encourage the activities of microbial antagonists.Actually, this is now a recommended practice everywhere.

In Pali Districts, extract of bark of Indian Mesquite (*Prosopis-juliflora*) and Aanwal (*Cassia auriculata*) is spread on chilli crop for protection against diseases like leaf curl, powdery mildew and leaf spots.

In Jalore and Barmer Zeera and Isabgol (*Plantago ovata)* face problem of wilt disease caused by *Fusarium Oxysporum*. Farmers are rotating the crop with Raida (Mustard) and wheat in *Rabi* and pearl millet (Bajra) during Khariff to reduce the incidence of wilt.

Artificially smearing of powder (Pollen grains) of male flowers of date palm in Kutch District of Gujarat on stigma of female flowers using brush brings about 100% pollination and fulfils/complete the requirements for fertilization. Actually, this is an age old practice adopted by Kutch farmers from Arabs.

Practices for better germination

Traditional practices which are used and found effective by many farmers' initially and can also be useful for other farmer's as part of sustainable agriculture are as given below.

Crush separation of rigma (seeds) of coriander (Dhaniya) using Chappals, a very common practice in Rajasthan/Gujrat and Madhya Pradesh. **Perhaps using of Chappal exerts only that much pressure, which is sufficient to separate the seeds without damaging the embryo.**

Smearing of curd in some parts of western Rajasthan and also in Gujarat before sowing seeds perhaps removes pathogens from seed surface particularly in cegetable crops

In Malwa region m**echanical scarification** of hard shelled seeds such as **cucurbits** reported to results into early and almost 100 % sprouting.

Azadirachta indica (Neem); Jamun; *Acorus calamus; Chenopodium album* (Cholai); *Eucalyptus* (Neelgiri); *Mentha arvensis* (Pudina); *Piper nigrum* (Kali mirch) and *Tetrademia & Laptadaemia* are some of the plant material which are known for effective seeds treatment.

Trichoderma

It is a fungus which normally found in soil. It has two varieties Trichoderma-virdi and Trichoderma – harzinium. It helps in controlling fungus which negatively affects the crops.

Using 6 gms Trichoderma per kg of seed helps in better germination for majority crops. Similarly in transplantation dipping roots of plants for 15 minutes in 10% solution of Trichoderma will help in better setting of plant.

Cow Pat Pit (CPP), Amritpani, Panchgavya and Agnihotra ash are recognised agents for seed treatment. These methods are described in old Sanskrit literature, and during recent years, their advocacy has been done even by the renowned scientists.

Use of 50% extract of **Krishna Tulsi as trap** for male adults of chikoo-moth (Bud borers) attracts males and reduces their population. This method was discovered and refined by Dr. B.G.Bagle in Central Gujarat on sapota crop.

Scientists in coastal Andra Pradesh indicated that practice of smoking ward off insect, pest and pathogens attack reducing storage loss and intern result in healthy nursery .

In paddy growing area of Banswara, Dungarpur and Panchmahal districts farmers store rice seed on the attics of kitchens. The smoke from the hearth results in fumigation effect for a longer period. This practice helps in maintaining high percentage of germination.

Practices to improve Soil life and Soil Quality

Indigenous practices in many regions have direct bearing on soil conservation and improvement of soil life resulting in optimising production. Following are some of the practices documented for this purpose.

Vedic Krishi Preparations and B.D-100 and B.D-500 preparations, which are now more prominently practiced in Switzerland i.e. Bio-dynamics are perhaps meant for increasing the population of **actinomyces** in soil.

Actinomyces are beneficial microbes. Bio-dynamics preparations are made by putting certain material in hollow cow horn and then burring it in field for some period and then sprinkling on soil.

Use of pond silt helps in improvement of soil fertility. Practices of de-silting the ponds and dam have helped replenish the soil fertility on one hand and improves water storage capacity of ponds on the other hand.

For the purpose of organic soil amendments farmers of Jaipur disrtict collect the leaves of besharam (*Ipomoea-biloba*) and Aak (*Calotropis* sp.) and kheemp (*Leptadaenia pyrotechnica*) cut and chaffed in a pot in equal ratio. They add ash, common salt, dung, livestock

produce improve and resistance against diseases and pests. Collect urine and excreta of bats and birds and allow it to rot for 2-3 months. This completely rotted manure is mixed with irrigation water and applied in onion, garlic and chilli crops for increased crop

4 litre ***chhachh*** diluted with 100 litres of water and spray on soil before sowing, it works as conditioner.

Value of **crop rotation** has long been recognised by different communities. But communities having limited land holdings have evolved practice of mixed cropping to include legumes in the farming system. It is well known that for years, traditional wisdom dictated the necessity of crop rotation because weed control and maintenance of soil fertility were the two dominant reasons.

Chinese and Greek communities also used crop rotation using beans (legumes) as source of soil enrichment 3000 and 300 years B.C respectively. In Europe, the Norfolk rotation (4 years rotation) is practiced while in HEBREW literature there are instruction to sow fields for 6 years but to let it rest for 1 year as fallow land.

Contour trench/bunding, field bunding are practice of hilly slopes in tribal areas of Rajasthan is known to be very ancient practice for soil and water conservation, conserving soil nutrients, increasing cultivable area and develop resiliance against wether variability.

5 Kg Trichoderma mixed in 100 kg vermicompost if applied in 1 ha land will improve soil structure and in-tern fertility

Innovative Practices in agriculture

From the view point of employment and poverty reduction particularly food security alone, it is important to take care of small farming. Besides being largely self supplying in food, fuel, fodder, nutrients and herbal medicines, small farms also feed an important part of urban population by promoting diversity based small farming, especially agro-forestry, high amounts of carbon dioxide can be tied up in soil organic matter layer and trees.

Many studies have indicated that multiple crop based small farms are more productive than monoculture.

Bio-fertilizers are gaining popularity day by day as they are capable of replacing chemical fertilizers and are eco friendly. A number of biological agents like *Trichoderma* and *Pseudomonas* hold great promise to act as competitor and biocide agents for control of devastating plant pathogens.

A number of bacterial fertilizers including *Rhizobium, Azotobacter, Azospirrilum* which increase Nitrogen availability while fungal bio fertilizers viz. Ectomycorrhiza and *Endomycorrhiza* which increase Phosphorus availability have been developed as commercial formulations, and can be used as cost effective substitutes for chemical fertilizers.

Vermi composting is also gaining required popularity as it is a low cost and effective option for manure production. It is a vermi-cast by earthworm feeding on biological waste material, plant residues. This compost is an odourless, clean, organic material containing adequate quantities of NPK and several micro nutrients essential for plant growth. It is eco-friendly, non toxic, consumes low energy input for composting and it recycles biological product. Advantages of vermi-compost are quick nutrient absorption by plants, almost negligible nutrient losses in comparison to chemical fertilizers.

In arid mixture sowing is practiced in which pearl millet is sown with Khariff legumes (Mung, Moth and cluster bean) sesame, cucurbits (melon) and citrullus (Tindsi) etc. This practice minimises crop losses due to onset of drought and prevents from the problem of 'rode' or soil crusting.

Fragmentations have made farm mechanisation uneconomic. Mixed and diversified farming system aims to maximise the system's diversity, emphasise soil fertility conservation and management, optimise use of energy is highly resilient.

Selection of local high yielding varieties based on experience provides hardy crops on account of climate change.

Adjusting the time of sowing to avoid pest damage, inter cropping, trap cropping and crop rotation have been found to provide adequate protection with no cost or a little cost without harmful effects on the environment. This strategy is found useful to reduce pest/disease incidence in case of sucking pests and viral/virus like diseases of several crops **like little leaf of brinjal, tomato leaf-curl, aphid and YVMV of okra, thrips of chilli, tomato spotted wilt virus of tomato and chilli, rust of wheat, late wilt of maize, etc.**

Though in water scares regions, flooding is not advised, but some farmers use it for management of insect and weed. It has been noted that fungi, bacteria and actinomycete populations decline in flooded soils. The anaerobic or near anaerobic conditions created by flooding are known to reduce the population of many fungal and soil pathogens. This is a common practice to reduce the inoculums of panama diseases and wilt pathogen *Fusarium oxysporum* f. sp.*musae*) in banana producing areas of Gujarat.

Selection and growth of native tree species for the best use of prevalent ecological conditions plantation of Mahua, Dhawadi, Palash, Jamun, Mango, etc. The native species well adapt to ecological and social conditions. Some other plants like Prosopis - cineraria (Khejadi), its leaves are used as fodder and its pods are used for vegetables. *I-undulata* is used for timber wood, *Acacia senegal* (Kumat) for gum, folder and fuel wood. However, they are much better suited to arid region than in semi-arid tropics.

Ber, Palash, Peepal and many indigenous trees are well known host of Lac-insect Homeoptera tachardeidae. It is natural non toxic resinous produce and contains three important products (resins, dye and wax) of commercial value. It has versatile uses in paints, printing inks, pharmaceuticals, cosmetics, electrical and automobile industry.

Lac mud is an industry effluent obtained while washing of Lac. It can be used as organic manure since it contains high quantity of NPK and organic carbon and used as FYM.

Increasing seed rate to compensate pest damage, at some places, seed germination is affected due to damage by vertebrate pests, termites or adverse weather. In such cases, the seed rate is often increased by 20 – 50%. This is true for several seed sown vegetables like cowpea, beans, okra, pumpkins, bottlegourd, etc.

To check soil erosion, multipurpose tree plantation also helps such as Teak, Sahjan, Neem, Mango etc, which yields fruits and timbers. In addition to above herbal crops such as Aonla, Harde, Behra also can be planted. Such plants contribute to enhance water retention capacity of land on one side and checking soil erosion and increasing soil fertility on the other side.

Chuha Niyantran

Dhature ke 3 fal (phorkar) evam 5 kilo pattiya Besharm (ipomea) ko 5 kilo pani me mila kar tab tak ubale jab 2 litre solution bache. Chhan kar bache patte jamin me gar de (ye bahul jahrile hote he). 1 kilo chane is ghol me dale. Jab chane ghol ko pura sokh le to inhe chuho ke bill ke pas rakh de, inhe khate hi chuhe mar jayenge.

Diversification in farming can provide cushion against climate variability drought, heavy rains. Along the farm fences if plants like palash (*Butea monosperma* or flame of the forest), Kusum (*Schleichera oleosa*), Ber (*Zizyphus mauritiana),* Babul (*Acacia nilotica*), etc. are planted, these plants will check soil erosion, fulfil fuel need, provide timber and can also be used for hosting.

Bio-intensive crop cultivation can help to grow healthy and tolerant – plants, grown on humus rich productive soil with carbon content of 2% or above. **Humus soil encourage beneficial organism, which control virus, fungus and insect attacks.** The Bio-intensive farming system can bring down most of the problems like imbalanced plant nutrition. Companion planting with crops like Tulsi, Garlic, Onion and marigold can deter many insects entering into the farm.

Most of the aromatic and medicinal plants do not require intensive farm inputs and can be cultivated under natural stress conditions. Such plants are chirata, giloy, Jatamasi, Kuth, Kutki, Tagar, Vankakdi, Lavender, Aconite, Kalihari, Sarpgandha, Aonla, Harad. Bahera, Shatavari, Senna, Guggal, Neem, Arjun, Brahmi, Shankhpushpi etc. Climate change will have little effect on, these plants and farmers will be less affected by it. These plants can be harnessed for their application in the development of cottage industries for preparation of ayurvedic medicines, dhoop, incense and havan samgri.

Conclusion

All above factors need the change in strategies in farming systems and technologies. For that following course of action is required:

1. Farmers need to adopt Integrated Farming System (IFS) and Agriculture Animal Husbandry System (AAS) incorporating combination of agriculture (seasonal and perennial), animals, poultry farming, aquiculture, insect farming (lac, honey, silk etc).

2. Involving micro-organisms to support 'crop' production

3. Involving birds (with due care and protection to crops) like Kite, Eagle, Crow, Owl, Maina, Bulbul, Goraiya, Baya, Muniya, Darjin, Red barbler, etc. which are normal predators for many pest and insects such as white ants and harmful insects.

4. Farmers will have to follow nutrient cycling approach in which agriculture and animal husbandry becomes complementary elements through multi-step processes using bio-digesters, gasifier, fermenter to accelerate nutrient release. Bio-activators will also play a useful role in increasing production and maintenance of ecological balance.

5. There is need to adopt **'Low External Input Sustainable Agricultural Approach'** and open forums for **'LEISA Schools and Research'** at local levels.

6. There are areas where mass technology and cooperation of local communities/NGO's etc. is required such as soil and water conservation, social forestry, seed bank, grain bank, local varietal selections and trials, water harvesting, group irrigation, lift irrigation and water sharing, water saving devices, forest produced collection to nearest markets etc.

7. A spectrum of micro enterprises based on underutilized crop residues, animal waste, non-timber forest-produce, processing or value addition activities can be started for getting optimum returns from the diversified cropping systems.

Therefore Farming Community, NGOS, Research Institutions, Agricultural Universities, Extension Agencies, Private Sector, Governments and International Agencies have to play effective role in fostering and promoting cooperation in achieving the goal of achieving food security in a collaborative spirit. The collective role would be-

1. Identify and evaluate possible adaptation mechanism.
2. Identify document and learn from past coping mechanism.
3. Analyse and empower communities to adapt as much as possible.

References

Gregory P.J., ingram J.S.I. and Brklacich, "Climate change and food security" downloaded from rstb.royal societypublishing.org.

Focus group discussion with community of Anandpuri, Ghatol, Dahod – VAAGDHARA.

Stern Nicholas, "What is the Economics of Climate change" world Economics, vol.7, No-2 April-June 2006.

Arun Kumar, "Traditional plant protection management of Rajasthan" LEISA India, Vol.9, No-4 December 2007.

Lanting mans, "Pest management: The art of mimicking nature" LEISA India, Vol.9, No-4 December 2007.

Miguel-A-Altieri, Luigi Ponti and clara I. Nicholls "Managing pests through plant diversification" LEISA India, Vol.8, No-4 December 2006.

Division of Agricultural Extension, ICAR "Proceedings of Secona National Conference on KVKs", 26-27 November 2006.

G.B. Pant University of Agriculture and Technology, Pant Nagar, 3rd National Conference of KVKs, December 27-29, 2008.

Gupta Savita "Fasal ki Shatru Deemak ka Prabandhan", Unnat Krishi, Jan.-June, 2007.

Singh R.K. and Mishra Y.D. "Lac-Aboom to rural Economy "Intensive Agriculture, Jan.-Feb., 2006.

Silvio G. de. Almeida and Gabriel. B. Fernandes, "Economic benefits of a transition to ecological Agriculture" LEISA India, Vol.8, No-2 June 2006.

VAAGDHARA

VOLUNTARY ASSOCIATION OF AGRICULTURE GENERAL DEVELOPMENT, HEALTH AND RECONSTRUCTION ALLIANCE

Head Office:

Opp.BVB School,Near Amardeep Nagar,Khandu Colony ,Banswara (Rajasthan)INDIA

Ph:+91-2962-257333, Fax:91-2962-257725,Mob.- +91-9414102643,

Branch:

Flat No. 501, 5th Floor, Vinayak Enclave, Opp. Post Office,

Nursery Circle, Vaishali Nagar, Jaipur, Ph. : 0141-4006924

Email: vaagdhara@gmail.com ,Website: www.vaagdhara.org