Draft Report

# Study the Impacts of GVNML Interventions in Adaptation and Mitigating Impacts of Climate Change

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**July 2010**

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# CHAPTER I

# INTRODUCTION

## 1.0 Background

The Third Assessment Report of Working Group II of the Intergovernmental Panel on Climate Change (IPCC) predicted that climate change would impose significant stress on resources throughout Asia. The Asian region is home to more than 60% of the world's population; natural resources are already under stress, and the resilience of most sectors to climate change is poor. Many countries are socio-economically dependent on natural resources such as water, forest, grass-land and rangeland, and fisheries, and changes to these resources as a result of climate change will have far-reaching implications. For example, food and fiber, biodiversity, water resources, coastal ecosystems and human settlements in South Asia are thought to be highly vulnerable to climate change. The impacts of climate change are expected to vary significantly across the different sub-regions and countries of Asia and certain countries will be able to cope better than others. The Least Developed Countries (LDCs), which are already struggling to tackle issues of poverty, health and education, are expected to be among the most vulnerable to climate change and extreme events because of their lack of economic strength, low level of institutional capabilities and greater dependence on climate sensitive resources. It is vital that realistic measures for adapting to climate change are developed for these vulnerable countries and integrated into their wider development agenda. Recognizing that climate change phenomena will seriously affect and alter the distribution, type and quality of natural resources of the country and the associated livelihoods of the people attempt was made to look at micro level the impact of climate change and how people cope or adapt it in a small area of Rajasthan.

In the past GVNML has made lot of interventions in rural areas of Rajasthan in the field of Natural resource management, mainly land, water and vegetation. Were these interventions helpful in addressing the emerging climate change issues, was the question bothering us time and again? Hence it was decided to commission a systematic

study on the subject. The objective was not to indulge in the scientific debate of quantifying carbon sequestration or emission of CO2 in the GVNML villages and measure changes in these because of past interventions. Rather the idea was to know how far the NRM related interventions helped adaptation to climate variability at the first stage, and secondly in mitigation or adaptation of impacts of climate change. The interventions made by GVNML were more from the point of view of providing sustainable livelihood to the rural population, yet directly indirectly they were addressing the emerging challenges of climate change. Therefore, the study is commissioned with the following objectives;

## 1.1 Objectives

- To list possible effects of Climate Change/Variability on agriculture and animal rearing sector (in the area where GVNML works) or livelihood of the people.
- Review existing document available with GVNML and analyze that what others wrote about GVNML interventions from the point of view of climate change or variability.
- Develop a document consisting details about how GVNML works enabled the society to cope with or adapt to the impact of climate variability/ change, particularly on agriculture and animal husbandry sector.

## 1.2 Methodology

GVNML came into existence in 1977 in a very severe drought year and formally registered as NGO in 1986. The main objectives were; (1) Building awareness of people about various roles and responsibilities for natural resource management. (2) To spread a sense of awareness to preserve forest, conserve water and protect wild life. (3) To create an environment so as to fight against drought. (4) To undertake activities to build social harmony and capacity of people to seek benefit of government development programmes in order to attain sustainable livelihood in rural environment. Frequent droughts made them to initiate voluntary action for repairing the water harvesting structure and developing common pastureland of villages as their first priority.

The GVNML interventions/actions were mostly addressing the climate variability issues affecting the livelihood of rural population. This study is an ex post analysis of GVNML interventions to know that whether these interventions addressed the issues of adaptation or mitigation of the impact of climate change. For this study range of tools were used, such as, desk review, collection of primary data by organizing village surveys (by designing appropriate questionnaire), focused group discussion with key informants and other stakeholders, and direct observations. In order to know the impact of interventions on the livelihoods of beneficiaries few households were randomly selected from the sample villages for detailed survey. Study was conducted by adopting participatory approach and had consultations also with PRI representatives.

Review of Sustainable Livelihood Framework (SLF) was undertaken to understand the relationship between SLF and the strategies of people to cope with or adapt or mitigate the impact of climate variability or change. Also relate the interventions planned by GVNML to the people's adaptation practices and how far these interventions helped in strengthening the coping or adaptations of the rural community. A brief review of the SLF is given below.

## I. Sustainable Livelihoods Framework

The Sustainable (Rural) Livelihoods Framework (SLF) was developed in the late 1990s and then widely promoted by the UK's Department for International Development (DFID). It quickly became widely used by all the major development organisations. Responding to earlier narrow visions of livelihoods (focused on economic or, even more narrowly, on financial aspects), the SLF defines a set of capabilities or assets, on the basis of which people construct their livelihoods (Figure 1). These assets and capabilities are commonly grouped under five headings:

- **Human**, e.g. education, formal and informal skills, health.
- **Natural**, e.g. natural resources such as farming and grazing land, forests and non-timber products, wildlife, and water.
- **Physical**, e.g. shelter, infrastructure such as roads and transport, buildings, irrigation systems, and productive assets such as seed, tools, livestock, fishing gear and other farm and processing equipment.
- **Financial**, e.g. cash income and remittances, credit, savings in kind and cash.

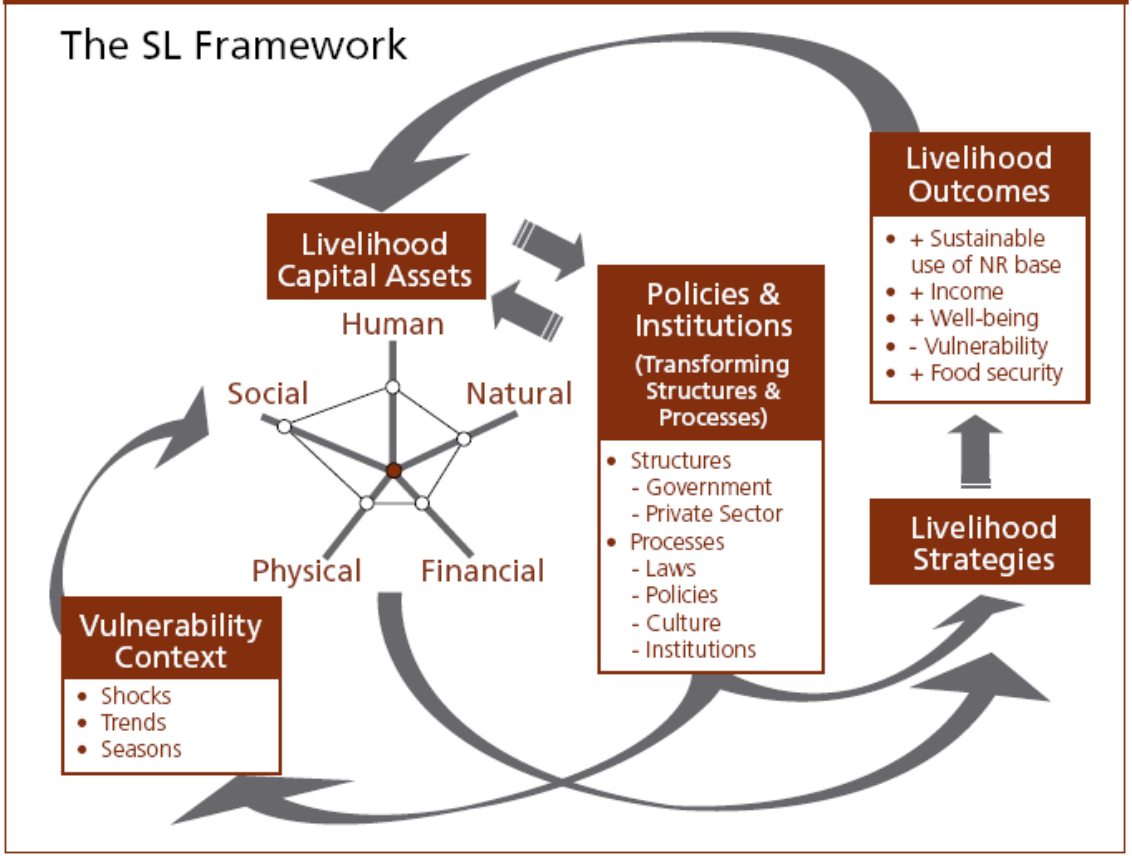
- **Social**, e.g. formal and informal institutions (including markets), associations (e.g. water users and savings and credit associations), extended families, and local mutual support mechanisms.

A livelihood can be considered sustainable when it 'can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base' (Chambers and Conway, 1992). The framework highlights the potential impact of policies, institutions, structures and processes on a household's assets and its vulnerability context, thus determining the livelihood strategy and outcomes achieved by a household (or other unit of analysis). Problems with the implementation of the SL framework have included:

- The five assets are intended to provide a multi-faceted view of livelihoods; however, many studies focus too much on collecting information for each asset at the expense of integrating the information (for which no agreed mechanism exists), resulting in a fragmented rather than a holistic understanding of impacts on livelihoods.
- Some users felt that certain aspects of livelihoods were not sufficiently captured by the five assets and added political, cultural, personal and/or organisational ones.
- The framework was originally designed for use at household level. It is now frequently also used at community level, which raises issues about how the 'assets' are defined at this level.
- Furthermore, how local-level processes are related to the national policy level is difficult to show using the framework.

In response to a view that the poor had actually been lost from view through too much focus on the asset pentagon, and a concern that the essential linkages between different elements of the framework were not represented effectively by DFID's diagram, the International Fund for Agricultural Development (IFAD) elaborated a new SL framework diagram (Hamilton-Peach and Townsley, 2004). Importantly, this also incorporated the aspirations of the poor and the opportunities they perceive for change, as well as indicating that 'the poor' are not a homogenous group, but differ by age, gender, class, etc.

**Figure 1.** DFID's Sustainable Livelihoods Framework diagram




Source: http://www.chronicpoverty.org/toolbox/Livelihoods.php

While DFID itself no longer explicitly promotes use of the SL framework, many other organisations have adapted it or developed their own definitions and approaches, which can easily be mapped onto the SL framework. All these cases include an explicit focus on 'political' systems, which was subsumed under 'social' assets in the original SL framework. Overall, application of the SL framework currently ranges from a very simplistic reference to the five assets to attempts to engage with the more complex reality displayed in the IFAD diagram.

## II. Causal models and 'theory of change'

A causal model is a form of conceptual framework with a focus on describing cause–effect relationships. Also known as a 'theory of change' model, this is a 'theory-based evaluation tool that maps out the logical sequence of means-ends linkages underlying a project and thereby makes explicit both the expected results of the project and the

actions or strategies that will lead to the achievement of the results' (GEF, 2009). The advantage of a causal model is that it explains how an intervention can give rise to specific outcomes and impacts, thus tackling the issue of attribution. Richards (2008) notes that causal models are commonly used in the microfinance sector, which has the advantage of being able to draw on a large body of econometric research showing how social outcomes are correlated with poverty reduction. One reason for using causal models is that, by outlining the process by which impacts are expected to be achieved, they can help to assess impacts of interventions that are too recent for long-term impacts to be evident. They are therefore potentially useful for environmental projects, the impacts of which occur slowly and may be difficult to measure directly. This is the case for many social assessment of conservation initiatives.

Global Environment Facility (GEF) projects, leading the GEF Evaluation Office to produce a draft practitioner's handbook (GEF, 2009) on what it terms 'Review of Outcomes to Impacts' (ROtI). The ROtI's theory of change approach allows for an 'assessment of the logical process linking outcomes to impact [which] is realistic to achieve during short evaluation missions, and provide[s] a potentially robust indirect measure of the ultimate impact' (GEF, 2009). While the causal models in the reviewed studies were all locally specific, there are more generic causal model frameworks. One of these is the 'Driving forces – Pressure – State – Impact – Response' (DPSIR) framework, an extension of the PSR (Pressure-State-Response) model, developed by Anthony Friend in the 1970s, and subsequently adopted by many European and international organisations for reporting on relationships between the environment and the economy (Yangang Xing *et al*., undated). The DPSIR framework has been modified for use in the Millennium Ecosystem Assessment (MA) and has also been proposed to the UN General Assembly for the global reporting and assessment of the state of the marine environment, including socio-economic aspects (UNEP and IOC-UNESCO, 2009). The DPSIR framework is used for organising information about the complex chain of cause-and-effect in the interactions between society and the environment and consists of several components.

In this framework *Driving forces* refer to economic, technological, social and even natural (e.g. temperature trends) factors that shape human activities exerting *pressures* on the

environment. The *pressures* are the specific ways that human activities lead to changes in the *state* of the environment and *impacts* on valued parts of ecosystems or on society. Impacts may trigger *responses* from regulating authorities or the private sector (UNEP and IOC-UNESCO, 2009). A DPSIR framework could be developed at the level of a protected area system or an individual protected area. As discussed above for causal models, a DPSIR cause–effect framework can be useful in helping to identify priorities and find the most efficient response measures. The attraction of the DPSIR is that it draws attention to drivers and pressures at various scales, including within and outside a protected area and might, therefore, assist in visualising the relative importance of the protected area versus other drivers and pressures affecting livelihoods in a locality.

As with the SL framework, it is possible to identify a number of advantages and disadvantages of a causal model in relation to rapid assessment of social impacts of protected areas:

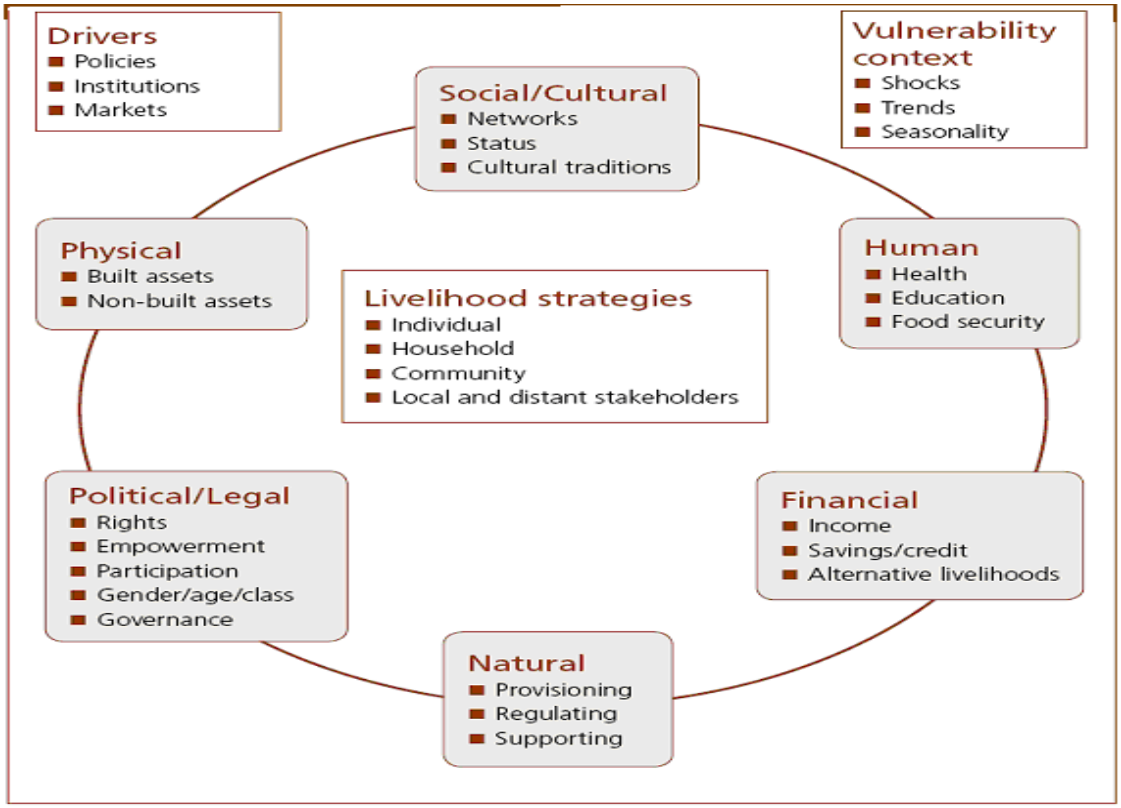
- Can help to overcome the attribution issue by describing expected links between the protected area and specific livelihood (and other) outcomes and impacts.
- Highlights the external drivers and pressures that may contribute (possibly more than the protected area itself) to the perceived social impacts.
- Provides an understanding of the process by which particular impacts are achieved (and often the key actors involved), making it easier to identify interventions to achieve desired change.
- Focuses on intended impacts and may, therefore, not uncover unexpected impacts.
- Methodologies, such as development of logical frameworks or problem trees, require skilled facilitation if process is to be truly participatory and understood by local communities.
- Difficult to use in retrospect.
- Fairly broad-brush approach – not easy to determine socially disaggregated impacts.
- If locally specific, then difficult to compare between sites or aggregate upwards.

## III. Millennium Ecosystem Assessment framework

Another conceptual framework of relevance for the current study is that developed by the Millennium Ecosystem Assessment (MA). It splits ecosystem services into supporting, provisioning, regulating and cultural services and then indicates how these four attributes relate to different aspects of human well-being. Well-being is defined as having ‘multiple constituents, including basic material for a good life, freedom of choice and action, health, good social relations, and security’ and being ‘at the opposite end of

a continuum from poverty' (Millennium Ecosystem Assessment, 2005). While there is a clear overlap between protected areas and ecosystems in the services they provide, protected areas with their associated management and governance structures and arrangements and cultural institutions are more than 'just' ecosystems. The MA framework is particularly useful, in combination with a livelihoods framework, as a means for taking a more detailed look at impacts on different aspects of natural assets. Based on the preceding discussion about conceptual frameworks, Figure 2 attempts to capture these issues in a slightly modified sustainable livelihoods framework. It includes the usual five assets of the original DFID version, with 'natural' assets being broken down (as in the Millennium Ecosystem Assessment) into provisioning, regulating and supporting services (cultural services – also included in the Millennium Ecosystem Assessment – are included under 'social' assets). Physical assets are broken down into built assets (e.g. housing) and non-built assets (e.g. the luxury goods). A sixth addition is the 'political/legal' asset, reflecting in part the focus on rights of both the rights-based approach as well as the latter's focus on empowerment. The different sets of assets and related opportunities together help determine livelihood strategies taken by individuals, households and even communities. As in the original sustainable livelihoods framework, decisions are also influenced by the vulnerability context and by other external drivers such as policies, institutions and markets. Note that the diagram does not represent any causal relationships and is simply a check-list of issues to be considered when developing a conceptual framework.

**Figure 2:** Modified Sustainable Livelihoods Framework

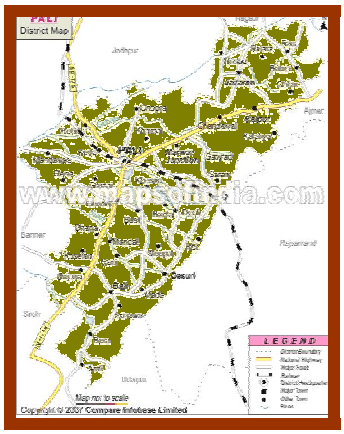



The above review will be the basis for analyzing the GVNML activities/interventions. Both frameworks, namely SLF and modified SLF makes it clear that there are four type of livelihood strategies and they are governed by internal and external factors. In the external factors climate variability and/or change plays a significant role in shaping these strategies. It is also important to note that the context in which the livelihood strategies are framed has to be well understood. The context can be physical, economic, social, political and environmental. Therefore in the subsequent chapter we will discuss the context under which GVNML planned for interventions by seeking active participation of people.

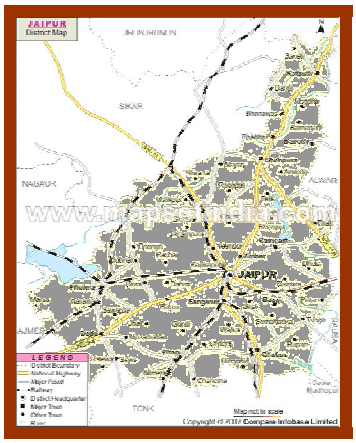
**Study Area** Dudu of Jaipur District, Malpura of Tonk District and Desuri in Pali District.

**Activity Area of GVNML**

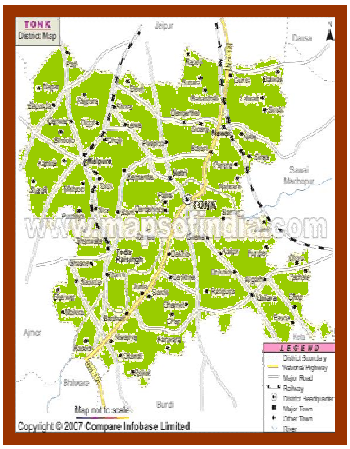

**GVNML Districts**



**Pali**



**Jaipur**



**Tonk**

## 1.3 IMPACTS OF CLIMATE CHANGE

As the understanding on global climate and its change, mostly human induced, increased over the time, one could see an increasing number of scientists and administrators accepting it as happening. It has also been agreed that the climate change vulnerabilities are related to the developmental state of a country, as indicated by the differential impacts of climate change on countries at different developmental levels. Also, a country's vulnerability to climate change is decided by the presence of appropriate mitigation and adaptation options. Climate change also demands that the current Vulnerabilities need to be looked from a different perspective. Within climate change adaptation community, there is a common assertion that if we could cope better with the present climate risks, possibly we could significantly reduce the impacts of future climate change. There are also views that the adaptation to short-term climate variability and extreme events serves as a starting point for reducing vulnerability to longer-term climate change.

In the last decade, a number of studies have been carried out on climate change impacts, vulnerability and adaptation measures in developing countries. The most damaging impacts of climate change for all South Asian countries will be to water resources and agriculture, and through natural disasters such as floods, droughts and glacier lake outbursts. These events already drastically affect livelihood of people residing in South Asia almost every year.

### *Water resources*

As regards the water related impacts of climate change is concerned some climate models predict an increase in frequency and intensity of droughts, increase in rainfall intensity, which may increase runoff, enhance soil erosion on cleared land and accelerate sedimentation in the existing water supplies or reservoirs. Not only will this reduce the potential of a catchment to retain water, but it will also cause water quality to deteriorate.

### *Agriculture*

Under a severe climate change scenario the expected potential shortfall in cereals and other crop production will range between 30 to 70%. Even under a moderate climate

change scenario the crop loss due to salinity intrusion could be 0.2 Mt annually. The anticipated drop in agricultural production, when coupled with losses in other sectors, will have a deep impact on the development prospects, severely threatening food security. The ultimate impact of loss of food grain production would be increase in food imports. The agricultural sector is the major source of employment in India and will remain so in the coming decades. Loss of both agricultural land and production will adversely affect people's livelihoods, especially among the rural poor.

The views of few other scientists are that there will be some positive impacts on agriculture from climate change and its causes, such as increased temperatures and higher carbon dioxide levels. While these may have positive impacts on crop yields, this is only where moisture is not a constraint. It is feared that moisture stress would be more intense during the dry season, which might force farmers to reduce area under cultivation of certain crops. Warmer temperatures may also increase the occurrence of extreme events or pests, again offsetting any potential benefits. Both crops and livestock would be affected by an increase in disease or alien/invasive pests. An increase in temperature, despite a reduction in humidity, can reduce the ability of farmers to work. As a result, low income rural populations that depend on traditional agricultural systems or on marginal lands are particularly vulnerable to climate change and livelihoods will be at risk.

The overall impacts of climate change will be far-reaching. The goal to reduce the number of people living below the poverty line by 50%, as stated in Millennium Development Goals. Climate change will jeopardise this noble ambition unless realistic adaptation measures are devised. Moreover, climate change may have other, more indirect consequences. Following past extreme events, the poverty driven rural population has migrated to urban centres. Such large-scale inter and intra state migration is likely to increase social unrest and exacerbate existing conflict situations.

In order to understand the GVNML interventions in two regions of Rajasthan, namely Eastern region (comprising of Jaipur and Tonk Districts) and Western region (Pali District)in an around 500 villages. In the context of Climate Change four villages were selected from Malpura and Dudu Tehsils and one village from Desuri Tehsil of Pali

District for detailed study. From these five villages in total 48 households were randomly selected for this study to understand as how the GVNML interventions helped in coping with or adaptation to the impact of climate variability/change in terms of their livelihoods in the villages. The details on sample villages is given in Table 1.1.

Table 1.1: Sample village wise, sex wise distribution of sample respondents.

| Village | No of household | Male | Female | Total |
|---|---|---|---|---|
| Balapura(Malpura | 10 | 90.0 | 10.0 | 100.0 |
| Laporiya(Malpura) | 10 | 100.0 | 0.0 | 100.0 |
| Maadpur(Pali) | 10 | 50.0 | 50.0 | 100.0 |
| Rahalana(Dudu) | 10 | 100.0 | 0.0 | 100.0 |
| Sailsagar(Dudu) | 8 | 100.0 | 0.0 | 100.0 |
| Total | 48 | 87.5 | 12.5 | 100.0 |

Source: Primary survey

At micro level, say in the GVNML villages, some of the above discussed impacts are evident. We have to look into the context under which the GVNML has made few interventions and how far those are able to address the impacts climate variability/change. Therefore, in the next Chapter II we present the contexts, i.e., physical, social, and economic condition in the GVNML intervention villages. Chapter III deals with the interventions made by GVNML and their impacts. In the last chapter conclusions and suggestions are given.

# CHAPTER II
# PHYSICAL AND SOCIAL ENVIRONMENT

## 2.0 Climatic context

Rajasthan climate encompasses a wide range of altitudinal zones and micro-climatic conditions. The State is divided into two meteorological sub-divisions, namely West and East Rajasthan. West Rajasthan has a climate: Tropical desert, Arid-hot (BWb). The southern part of the State have a climate type marginally varying between the types Tropical Savanna-Hot, seasonally dry (AW) and Interior Mediterranean, Mild winter; dry summer; Hot Summer (Csa). The remaining part of the State (GVNML intervention area lie in it) belongs to the climate type: Tropical Steppe, semi-arid; Hot (Bsh).

## 2.1 Physical and Environmental Context

The study area belongs to Jaipur district, used to be a part of the former Jaipur State. In the district there are five sub divisions namely; Jaipur, Dausa, Kothputali, Sambher and Amber and fifteen tehsils viz. Jaipur, Chaksu, Sanganer, Bassi, Dausa, Lalshot, Sikrai, Baswa, Kothputali, Bairath, Phulera, Phagi, Dudu, Amber and Jamuwa Ramgarh. Our concerning tehsils are Phulera, Phagi, Dudu and Chaksu. These tehsils lies in the Sambher sub division and it occupies the western part of the district. The physical and environmental features of these areas are as follows.

**2.1.1 Topography**: The Jaipur district has a roughly elliptical shape, broadest at centre and tapering towards east and west with a narrow area extending northward. The district belongs to the northern part of the east Rajasthan. Upland has a checkered mosaic of rugged mountainous terrain, upland basin and dune fields. The Southern part of the district where the NGO's working area is located belongs to the South-Jaipur Upland. The South-Jaipur Upland varying in height from 360 meters to 450 meters above mean sea level.

Pali district resembles an irregular triangle and have generally undulated plains with scattered hills here and there and the area may be called Sub-mountainous. The Aravali

Range runs along the eastern side of the district from south west to north east, its highest peak in district being 1099 meters. The rivers in the district mostly flow from east to west.

**2.1.2 River System and Water Resources**: The working area of GVNML lies in the Banas River Basin. The two main tributaries of Banas River are, namely Bandi and Mashi, which originates from the hills of Samod and Ajmer district respectively. These tributaries are fed by large number of small rivulets originating from the plains of tehsil Sanganer, Dudu, Chaksu, Malpura, etc. All of them are non-perennial rivers.

The depth of ground water resources in the GVNML working villages varied between 5 meters to 25 meters in 1971, which has presently gone deep and the area has been declared as dark zone.

Pali Rivers: There is no perennial river in the district and the Luni with its four tributaries, Lilri, Sakri, Bandi and Jawai, is the only river of same consequence, though it does not originate in the district. With no perennial rivers and scanty rainfall, the district had no flood problems. There are a number of other seasonal rivulets and streams which traverse through the district.

There are five large and medium tanks in the district namely Jawai, Raipur Luni, Hemawas, Kharda and Biratiya khurd, all for irrigation purposes. Jawai dam has the largest capacity of 198, 2176 MCM, while smaller tank is Walar having capacity of only 0.1699 MCM. Beside these there are at least 28 other small and big tanks.

### 2.1.3 Geology

Geological antiquity and Formation in Jaipur district: A large part of district covered by the thick mantle of soil, blown sand and alluvium. The oldest rocks in the district are the schists, gneisses, migmatites quartzite and conglomerates of Pre- Delhi formation. These rocks are mostly covered by a mantle of sand of sand and alluvium of recent to Sub- recent age. Overlying these rocks with a major unconformity is the rock of Delhi Super group which is made up of Raialo, Alwar and Ajabgarh Groups. The rock of the Raialo Group comprises of mainly dolomitic marble and minor quartzites. The Alwar Group consists of quartzite mica schists and conglomerates, which either lie un-

conformably over the Raialo or directly over the metamorphites of Pre-Delhi formation. The Ajabgarh Groups is mainly made up of schist, phyllites, marble and quartzite. These rocks have been intruded by amphibolites, granites, pegmatites and quartz veins.

The general geological succession in Jaipur district is summarized as follows:

| | | |
|---|---|---|
| Recent to Sub- Recent | | Below sand and alluvium |
| Post- Delhi intrusive | Ajabgarg Groups | Amphibolites, granites, pegmatites, quartz veins and basic intrusive<br>Pure quartzite, quartz-biotitemusco-vite-schist, phyllite and quartzite. |
| Delhi Supergroupds | Alwar Groups<br>Raialo Groups | Kushal garh lime stone.<br>Quartzite, marble, quartz-biotite schist, mica schist, feldspathic quartzite and conglomerate.<br>Quartzite, feldsphethic Quartzite and marble. |
| Pre-Delhi rocks | | Quartzite, mica schist, conglomerate and gneisses. |

*Geology of Pali District***:** The rocky outcrops are exposed mostly in the eastern part of the district and occupy nearly 16 percent of the area. The rest is covered by soil and sand.

Geological Antiquity and Formation in Pali district is characterized by the following formations of the geological systems of different areas:

| Age | Geological Formation |
|---|---|
| Quarternary | Recent and Sub- Recent: Soil, alluvium blown sand, kankar. |
| Palaeozoic | Trans-Aravalli Vindhyans: Sandstones, limestones and dolomites. |
| Post Delhi Intrusives | Malani rhyolites and Jalore granite; Erinpura granite and its derivatives, Epidiorities, Amphibolites. |
| Algonkian or Proterozoic | Delhi System: Mainly quartzites; schists and impure calcareous rocks. |
| Archaean | Raialo series: Mainly limestone and marble, partly dolomitic.<br>Aravalli system: Dark to purple slates, quartzites, argillaccous sandstones and schists.<br>Per-Aravalli Group: Gneisses, felspathic schists and granites. |

Source: Rajasthan District Gazetteers - Pali, pp6.

**2.1.4 Soils**: The soils of the region suffer variously in the different soil regions from excessive drainage, low water retentive capacity, moderate erosion by wind, and

low fertility in Chaksu and Bassi areas. Salinity, alkalinity, poor drainage accompanied moderate to severe erosion are the problem of soil in Naraina to Dudu, Chandrana-Padasoli and Chandran-Bandikui associated areas. Fast flowing nullahs and rivers during the rainy season cause erosion of soils near their banks. Occasionally flooded river inundate areas and silting is caused by flood channels and drainage.

Soil conservation programme implemented by the state government include land leveling, contour bunding, nullah bunding, etc. on cultivators' fields and on government lands as a regular programme as well as under famine relief measures.

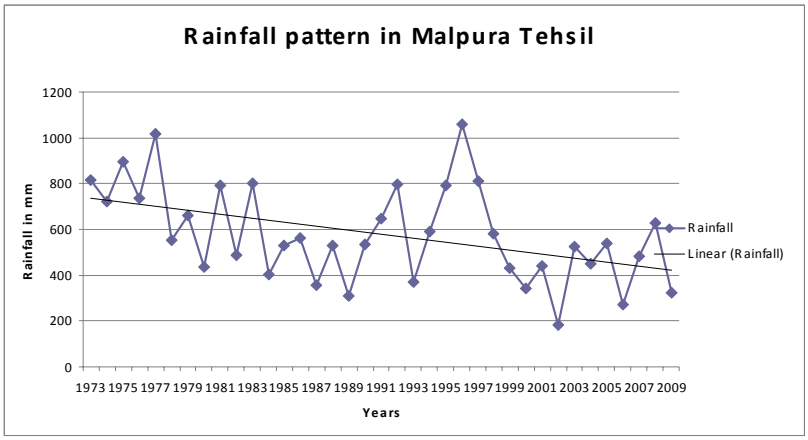
Geologically the soils in the region have been derived from older alluviums of recent and sub- recent origin. On the basis of sub-soil characteristics, the soils have been classified in to fallowing categories: Naraina- Dudu-Association, Chandrana-Padasoli Association and Padasoli-Phagi Association.

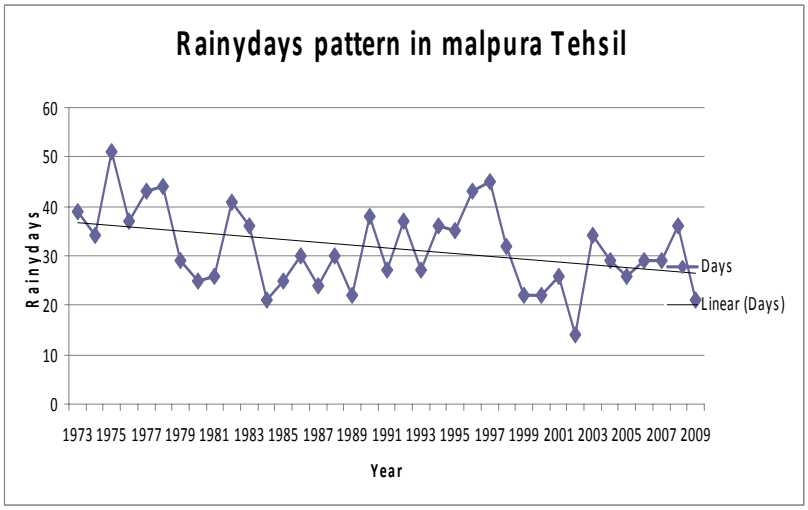
What emerges out of the above description is that there are inherent physical limitation of the soils in the area therefore while planning NRM interventions, such as, water harnessing structures, soil conservation works, plantations, etc. these constraints have to be kept in mind.

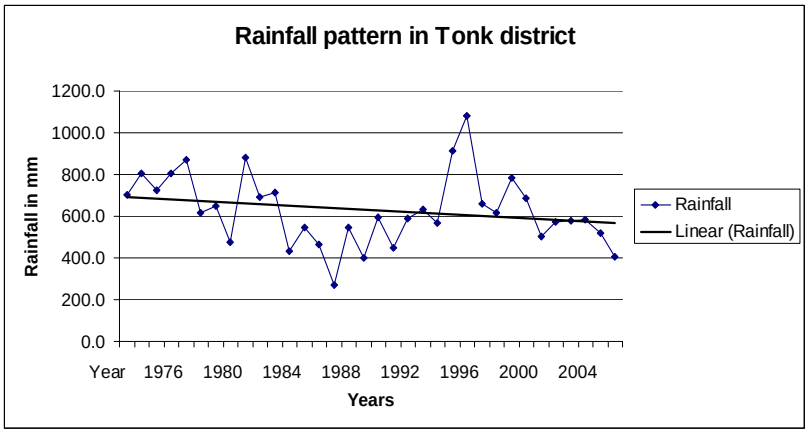
*Soils of Pali district*: Soils in the district are generally shallow in depth varying from 60 cm to 183 cm. Sub- strata is either rocky or has a calcarious layer. Hard sub-soil pan has given rise to salinity. The district can be divided into three regions from the point of view of soil characteristics. The first region, comparing of Bali, Desuri and Rani Panchat samiti areas has loam to heavy loam soil with rocky layer below, ranging from 60 cm to 180 cm.

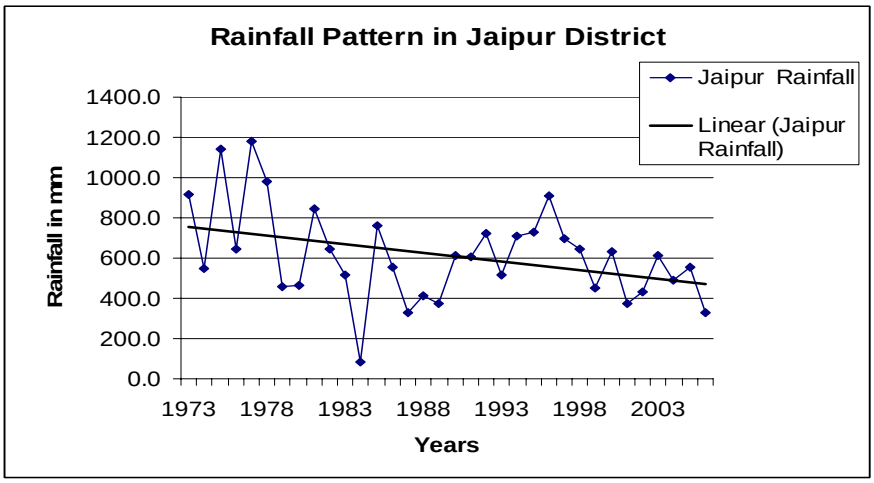
**2.1.5 Rainfal**l: There is high rainfall variability in the GVNML villages. Occurrence of drought of high and moderate intensity is a common phenomenon. Average rainy days in the study area are 32 with rains of 450 to 650 mm a year. The variability in rainfall and rainy days in the tehsils where the NGO works is shown in the following graphs. These graphs reveal that rainfall is declining in all the tehsils and same is the trend in rainy days. There is sharp decline in the rainfall both in Dudu and Malpura tehsils the main

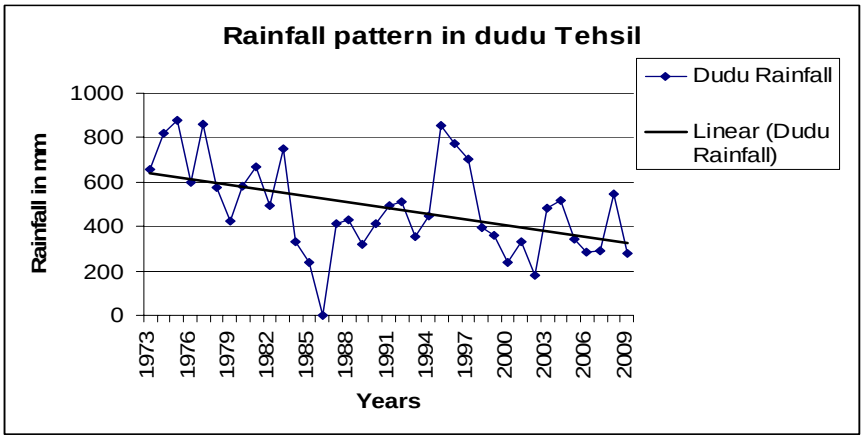
area of intervention by GVNML. Is this because of climate change or part of climate variability has to be established. However, this changing rainfall phenomenon is a challenge before GVNML, as how to augment water supply and meet the increasing drinking water and agricultural demand in the area.

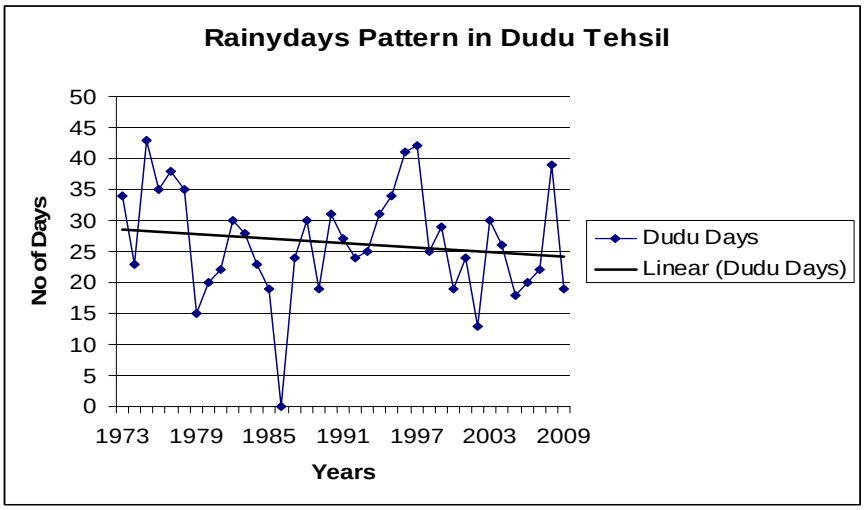


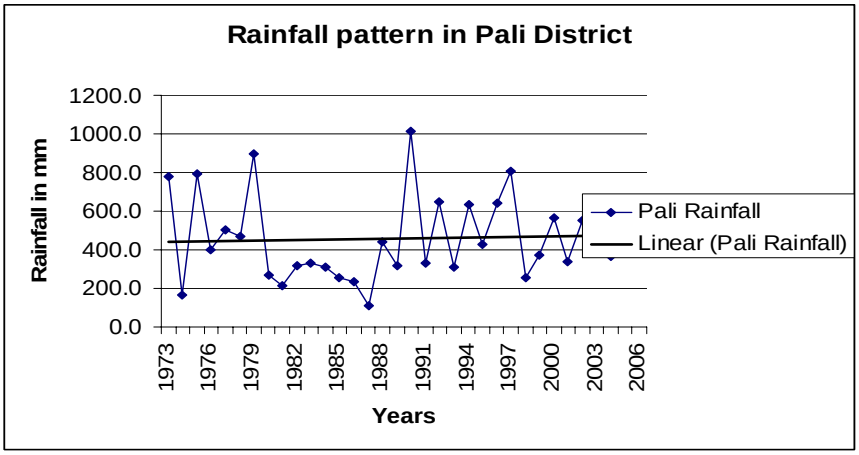



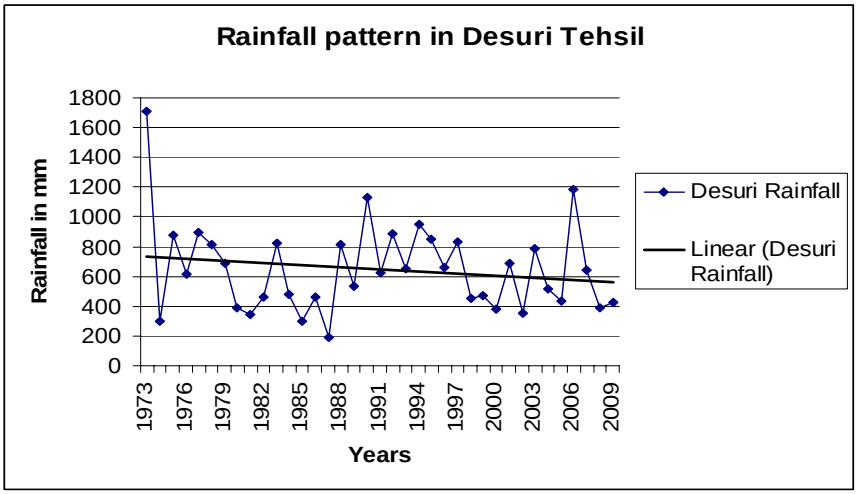

Rainfall pattern in Tonk district
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
Rainfall in mm
Year 1976 1980 1984 1988 1992 1996 2000 2004
Years
Rainfall
Linear (Rainfall)

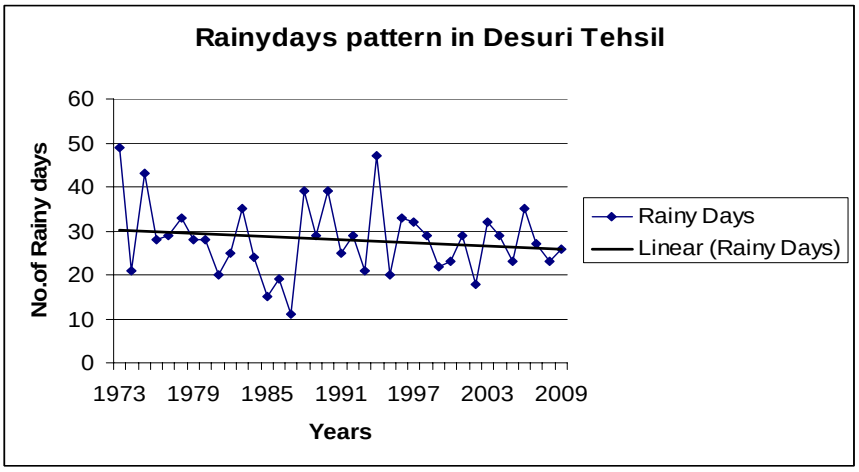

Rainfall Pattern in Jaipur District
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
Rainfall in mm
1973 1978 1983 1988 1993 1998 2003
Years
Jaipur Rainfall
Linear (Jaipur Rainfall)


Rainfall pattern in dudu Tehsil
1000
800
600
400
200
0
Rainfall in mm
1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009
Years
Dudu Rainfall
Linear (Dudu Rainfall)

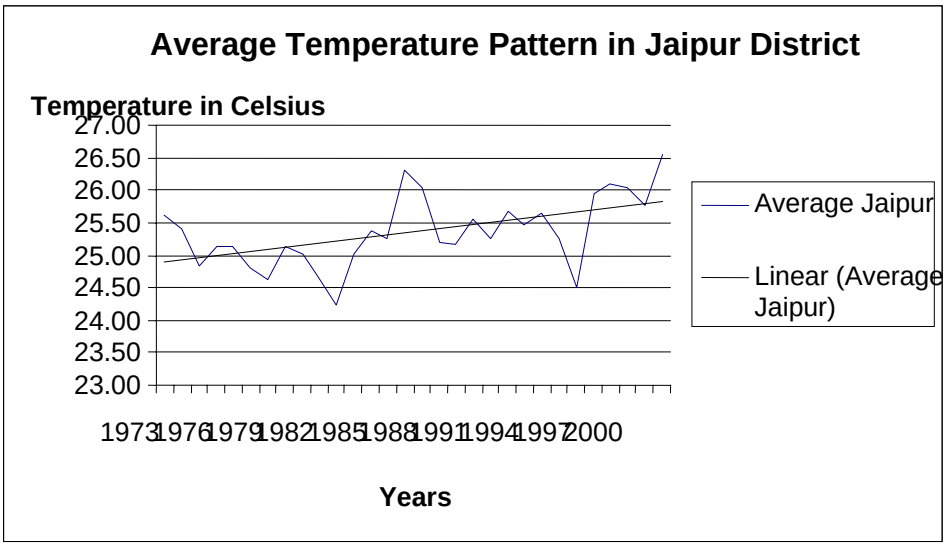

Rainydays Pattern in Dudu Tehsil
No of Days
50
45
40
35
30
25
20
15
10
5
0
1973
1979
1985
1991
1997
2003
2009
Years
Dudu Days
Linear (Dudu Days)

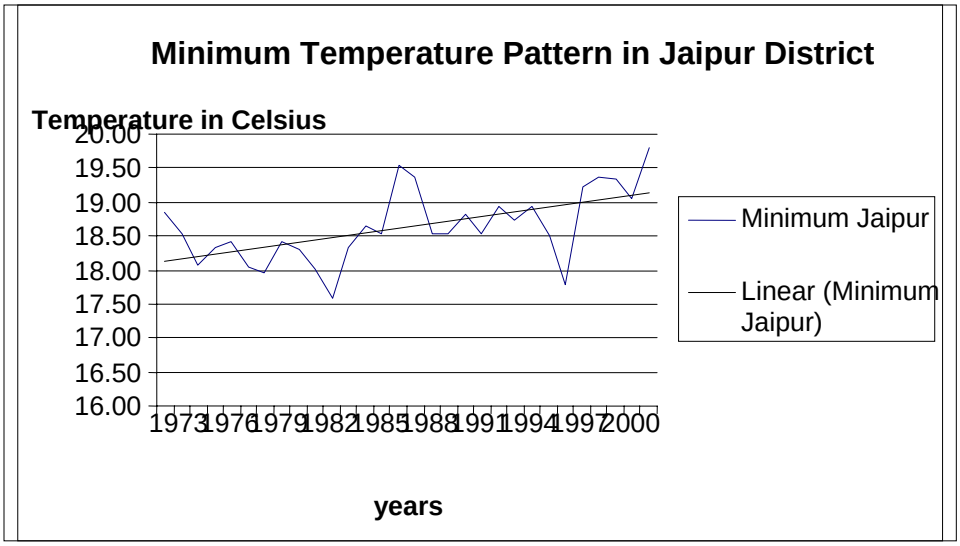

Rainfall pattern in Pali District
Rainfall in mm
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
Years
Pali Rainfall
Linear (Pali Rainfall)

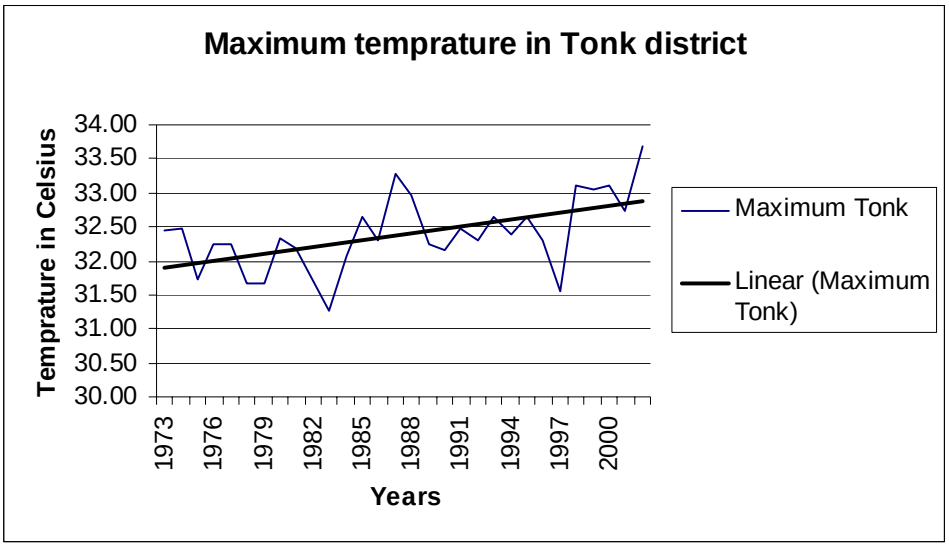

Rainfall pattern in Desuri Tehsil
Rainfall in mm
1800
1600
1400
1200
1000
800
600
400
200
0
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
Years
Desuri Rainfall
Linear (Desuri Rainfall)

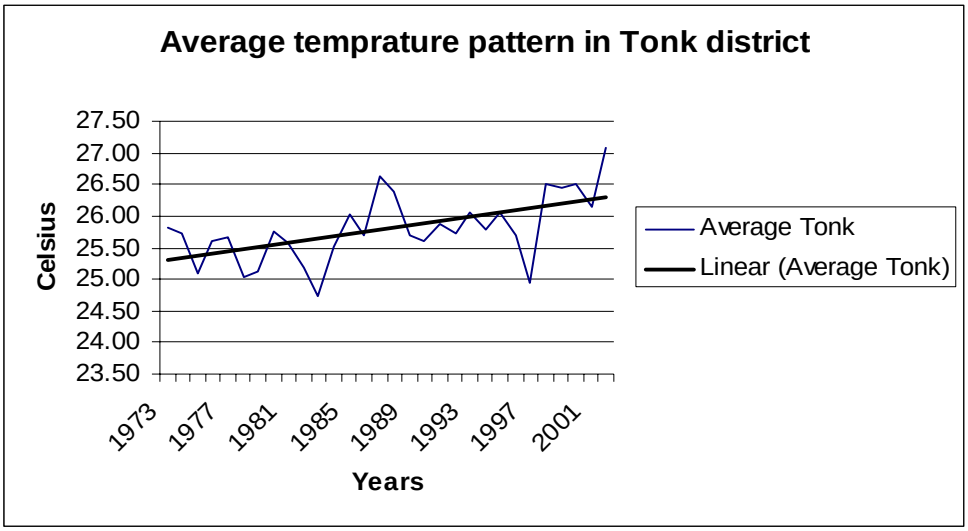


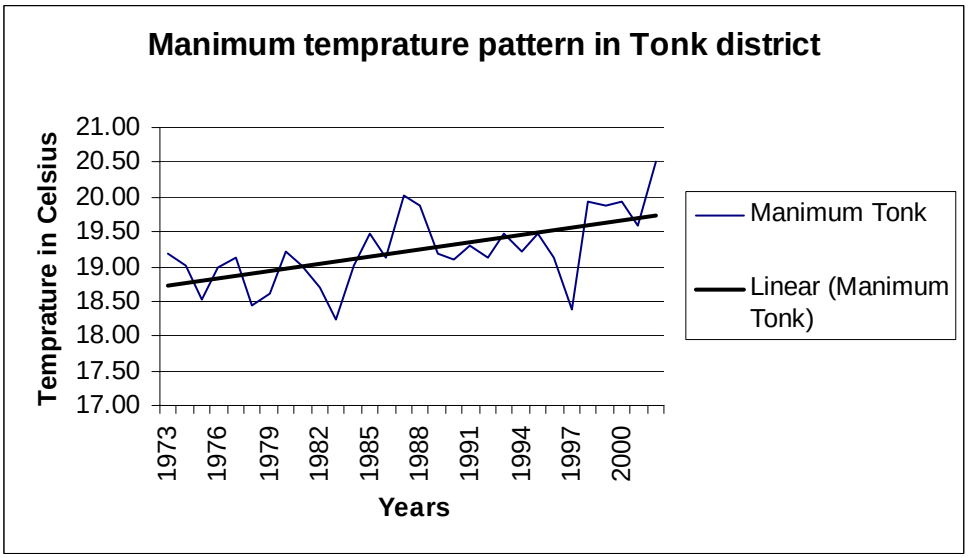

**2.1.6 Temperature**: Temperature affects people, agriculture, livestock and biomass in many different ways and is the most prominent parameter of climate change. May-June is the hottest part of the year in the project area. Day temperature varies between 25.8$^{o}$C to 45$^{o}$C and some time even 48$^{o}$C. Setting of south- west monsoon takes place after the middle of June and withdrawal of monsoon by mid-September. January is the coldest month the day temperature varies between minimum of 8.3$^{o}$C to 22$^{o}$C. The pattern of average temperature of Jaipur and Tonk districts is shown in figures below. The figures show that the average, minimum and maximum temperatures have raisin by almost one degree centigrade in last 30 years. Again the question is whether it is part of climate variability or because of climate change?




Minimum Temperature Pattern in Jaipur District
Temperature in Celsius
20.00
19.50
19.00
18.50
18.00
17.50
17.00
16.50
16.00
1973 1976 1979 1982 1985 1988 1991 1994 1997 2000
years
Minimum Jaipur
Linear (Minimum Jaipur)

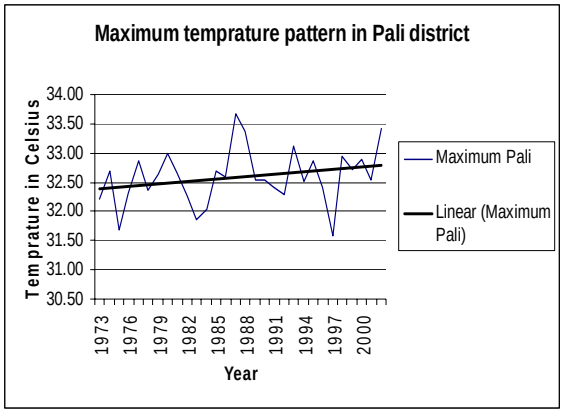

Maximum temprature in Tonk district
Temprature in Celsius
34.00
33.50
33.00
32.50
32.00
31.50
31.00
30.50
30.00
1973 1976 1979 1982 1985 1988 1991 1994 1997 2000
Years
Maximum Tonk
Linear (Maximum Tonk)

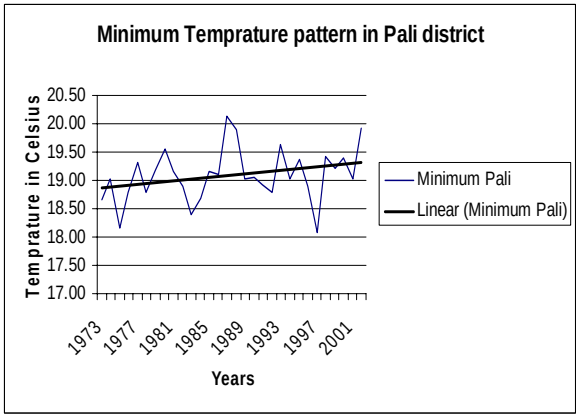


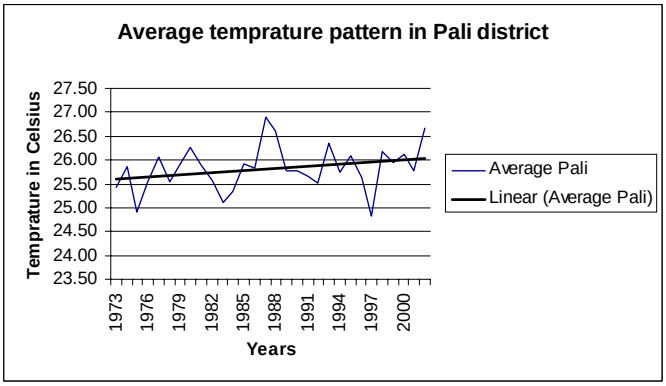




*Pali Climate*: The climate of the Pali district is on the whole dry with a hot season comparatively milder than the adjoining districts to the north and north-west. The average annual rainfall in the district is 472mm. The rainfall generally decreases from the south-east to north-west in the district. The rainfall during the period from June to September constitutes about 93 per cent of the annual rainfall. August is the rainiest month. There is considerable variation in the year to year annual rainfall. Consecutive drought even for, 4,5, and 6 Years were recovered during last 100 years, therefore,

district is liable to frequent droughts. On an average there are 22 rainy days with rainfall of 2.55 mm or more in a year. The numbers are between 16 to 27 days.




**2.1.7 Humidity**: During the brief south west monsoon the relative humidity is generally over 60 per cent. In the rest of year the air is dry. In the summer season, which is also the driest part of the year, afternoon humidity is as low as 15 to 20 percent.

## 2.2 Socio-economic Context

In Rajasthan the regions, namely tribal (Mewar), desert (Marwar), Shekhawati, Dundhad and Hadoti regions, significantly differ in cultural and socio-economic conditions. The relevance, effectiveness and outcome of rural development interventions by the State or NGOs are largely based on socio-economic context of the area.

After the Independence, particularly the transition period 1950 to 1960, therewas shift from feudal control over natural resources to almost no controls. It was that period people took liberty to cut forests, village vegetation, uncontrolled grazing, etc. Also it was the period when traditional institutions of village common property resource management systems broke down. Within few years natural resources were in bad shape. Then came the Panchyat Raj regime and management systems were restored but by that time it was too late and also the democratic management was less effective in controlling the over exploitation of resources. The change in mentality/perception of people from community management of resources to privatization of resources became threat for the future management of community resources.

Population growth rate as shown in Table 2.1 increased at much higher rate than the national average, resulting in increase in pressure on all the natural resources, i.e., land, water and biomass. Density of population has increased many fold also there is decrease in the size of holding and increase in unemployment in the districts.

As regards the social composition of the population the age old social classification of Hindu society based on Varnashram Dharma is still visible in the area. Hindus are divided into numerous castes and sub- castes. The social values were changing fast. Caste based reservations in government jobs, caste wise polarization of people during assembly election and others rural development activities had fractured the community based system in villages. With increase in literacy rate people started joining non-farm employment stream.

The official caste classification and distribution of rural population in the GVNML working districts is reported in Table 2.2. The SC and ST population account for less than 30 percent of total rural population. However in the villages where GVNML had their activities the micro picture is slightly different as shown in the next section. This information is based on a very small sample and hence the sample error has to be taken in account while interpreting the results.

**Table 2.1: Deicidal growth of population in Jaipur, Tonk and Pali Districts of Rajasthan**

| District /Year | Male | Female | Total | Difference in 10 years | %growth | Density |
|---|---|---|---|---|---|---|
| **Pali** | | | | | | |
| 1931 | 242050 | 231013 | 473063 | - | - | 38.2 |
| 1941 | 285892 | 269694 | 555586 | 82523 | 17.44 | 44.9 |
| 1951 | 339626 | 321230 | 660856 | 105270 | 18.95 | 53.4 |
| 1961 | 414615 | 391067 | 805682 | 144826 | 21.91 | 65.0 |
| 1971 | 497462 | 472540 | 970002 | 164320 | 20.40 | 78.3 |
| 1981 | 654784 | 619720 | 1274504 | 304502 | 31.39 | 102.9 |
| 1991 | 759816 | 726616 | 1486432 | 211928 | 16.63 | 120.0 |
| 2001 | 918856 | 901395 | 1820251 | 333819 | 22.46 | 146.9 |
| **Jaipur** | | | | | | |
| 1931 | 551458 | 493732 | 1045190 | | | 93.8 |
| 1941 | 621803 | 567934 | 1189737 | 144547 | 13.83 | 106.8 |
| 1951 | 794665 | 729838 | 1524503 | 334766 | 28.14 | 136.8 |
| 1961 | 1006134 | 895622 | 1901756 | 377253 | 24.75 | 170.7 |
| 1971 | 1313618 | 1168767 | 2482385 | 580629 | 30.53 | 222.8 |
| 1981 | 1814657 | 1621515 | 3436172 | 953787 | 38.42 | 308.4 |
| 1991 | 2055259 | 1832636 | 3887895 | 451723 | 13.15 | 348.9 |
| 2001 | 2768203 | 2482868 | 5251071 | 1363176 | 35.06 | 471.2 |
| **Tonk** | | | | | | |
| 1931 | 155210 | 142065 | 297275 | | | 41.3 |
| 1941 | 173309 | 156481 | 329790 | 32515 | 10.94 | 45.8 |
| 1951 | 211336 | 195585 | 406921 | 77131 | 23.39 | 56.6 |
| 1961 | 260589 | 237140 | 497729 | 90808 | 22.32 | 69.2 |
| 1971 | 327806 | 298024 | 625830 | 128101 | 25.74 | 87.0 |
| 1981 | 406530 | 377105 | 783635 | 157805 | 25.22 | 108.9 |
| 1991 | 506928 | 468078 | 975006 | 191371 | 24.42 | 135.5 |
| 2001 | 626436 | 585235 | 1211671 | 236665 | 24.27 | 168.4 |

**Table 2.2: Caste composition of rural population in GVNML districts.**

| Districts | SC | ST | Others | Rural Population |
|---|---|---|---|---|
| Pali | 18.4 | 6.7 | 74.1 | 100.0 (1429000) |
| Jaipur | 16.6 | 12.0 | 71.3 | 100.0 (2659000) |
| Tonk | 20.2 | 14.9 | 64.9 | 100.0 (959000) |

Note: Figures in parenthesis are numbers.

In order to capture the prevailing socio-economic condition in the GVNML intervention villages, rather than a comprehensive survey a small survey was planned in six villages because of the time and cost constraints. In total 48 sample households were randomly selected from six villages as given in the Table 2.3. A questionnaire was prepared for detailed survey and the results obtained from the randomly selected sample households are discussed below.

**Table 2.3 Sample villages and households.**

| Village | District | No. of household |
|---|---|---|
| Balapura | Tonk | 10 |
| Laporiya | Jaipur | 10 |
| Maadpur | Pali | 10 |
| Rahalana | Jaipur | 10 |
| Sailsagar | Tonk | 8 |
| Total | | 48 |

Source: Primary survey

The sample village area, total number of households and sex wise distribution of population as per the Census of India records for the sample villages is reported in Table 2.4. Sex ratio seems to be favourable in the sample villages.

**Table 2.4: Area, number of households & population in sample villages.**

| Village | Area | Total household | Total population | Male | Female | Sex ratio |
|---|---|---|---|---|---|---|
| Balapura(Malikpur) | 1461 | 237 | 1551 | 758 | 793 | 1046 |
| Laporiya | 1160 | 74 | 494 | 250 | 244 | 976 |
| Maadpur | 1099 | 169 | 873 | 422 | 451 | 1069 |
| Rahalana | 2845 | 515 | 3193 | 1640 | 1553 | 947 |
| Sailsagar | 509 | 95 | 589 | 310 | 279 | 900 |
| Total | 7074 | 1090 | 6700 | 3380 | 3320 | 982 |

Source: Census of India 2001

Sex wise distribution of population as per the primary survey conducted in the sample villages selecting ten households randomly from each village, is reported in Table 2.5.

**Table 2.5: Distribution of sample household population by sex in selected villages**.

| Village | Male | Female | Male Child | Female Child | Total Family | Male | Female | Sex Ratio |
|---|---|---|---|---|---|---|---|---|
| Balapura | 24 | 26 | 20 | 20 | 90 | 44 | 46 | 1045 |
| Laporiya | 37 | 30 | 18 | 14 | 99 | 55 | 44 | 800 |
| Maadpur | 19 | 19 | 18 | 13 | 69 | 37 | 32 | 865 |
| Rahalana | 18 | 16 | 22 | 17 | 73 | 40 | 33 | 825 |
| Sailsagar | 16 | 20 | 18 | 15 | 69 | 34 | 35 | 1029 |
| Total | 114 | 111 | 96 | 79 | 400 | 210 | 190 | 905 |

Source: Primary survey

The caste wise distribution of sample household population is given in Table 2.6. It shows that GVNML has chosen villages where socially marginalized groups have dominance over other castes. The sample villages had higher percentage of households belonging to Other Backward Caste (OBC) and Scheduled Caste (SC) category.

**Table 2.6: Cast wise distribution of sample households**

| Village | SC | ST | OBC | General | Total |
|---|---|---|---|---|---|
| Balapura | 10.0 | 0.0 | 90.0 | 0.0 | 100.0 |
| Laporiya | 20.0 | 0.0 | 70.0 | 10.0 | 100.0 |
| Maadpur | 30.0 | 0.0 | 40.0 | 30.0 | 100.0 |
| Rahalana | 0.0 | 10.0 | 70.0 | 20.0 | 100.0 |
| Sailsagar | 0.0 | 0.0 | 100.0 | 0.0 | 100.0 |
| Total | 12.5 | 2.1 | 72.9 | 12.5 | 100.0 |

Source: Primary survey

The basic amenities available in the sample villages, which are directly linked to the living conditions and livelihood of the people, are reported in Tables 2.7 to 2.9. There is still 30 percent population as illiterates. The villages lack medical and transport facilities. Except one sample village namely Selsagar all other villages have electricity supply. Handpumps and wells are the source of drinking water.

**Table 2.7: Education level of Respondents**

| Village | Illiterate | Literate | Primary | Middle | Higher Secondary | Total |
|---|---|---|---|---|---|---|
| Balapura | 30.0 | 20.0 | 0.0 | 40.0 | 10.0 | 100.0 |
| Laporiya | 20.0 | 20.0 | 20.0 | 30.0 | 10.0 | 100.0 |
| Maadpur | 50.0 | 20.0 | 0.0 | 0.0 | 30.0 | 100.0 |
| Rahalana | 20.0 | 30.0 | 20.0 | 20.0 | 10.0 | 100.0 |
| Sailsagar | 25.0 | 25.0 | 0.0 | 25.0 | 25.0 | 100.0 |
| Total | 29.2 | 22.9 | 8.3 | 22.9 | 16.7 | 100.0 |

Source: Primary survey

**Table 2.8: Basic amenities in sample villages**

| Village | Education Facility | Medical Facility | Drinking water Facility | Post and telegraph Facility | Bus Facility | Rail Facility | Electricity Supply |
|---|---|---|---|---|---|---|---|
| Selsagar | yes | No | Yes | No | No | No | No |
| Malikpur | yes | Yes | Yes | Yes | No | No | Yes |
| Laporiya | yes | No | Yes | Yes | No | No | Yes |
| Rahlana | yes | Yes | Yes | Yes | Yes | No | Yes |
| Mandpur | yes | No | Yes | Yes | No | No | Yes |

Source: Census of India 2001

**Table 2.9: Sources of drinking water in sample village**

| Village | Drinking Water Sources | | | | |
|---|---|---|---|---|---|
| | Tap | Well | Tank | Tube well | Hand pump |
| Selsagar | No | Yes | No | No | Yes |
| Malikpur | No | Yes | Yes | No | Yes |
| Laporiya | No | Yes | Yes | No | Yes |
| Rahlana | Yes | Yes | Yes | Yes | Yes |
| Mandpur | No | Yes | No | No | Yes |

Source: Census of India 2001

As regards housing conditions the type of houses owned by sample households is reported in Table 2,10. On an average 50 per cent households have Kutcha houses, 43.8 percent semi-kutcha and only6.6 percent have pucca houses.

**Table 2.10: Type of House owned by sample households.**

| Village | Kutcha | Semi Pucca | Pucca | Total |
|---|---|---|---|---|
| Balapura | 100.0 | 0.0 | 0.0 | 100.0 |
| Laporiya | 40.0 | 60.0 | 0.0 | 100.0 |
| Maadpur | 30.0 | 60.0 | 10.0 | 100.0 |
| Rahalana | 40.0 | 50.0 | 10.0 | 100.0 |
| Sailsagar | 37.5 | 50.0 | 12.5 | 100.0 |
| Total | 50.0 | 43.8 | 6.3 | 100.0 |

Source: Primary survey

*Assets*: Land is the major asset owned by rural population, and livestock, house, agricultural implements and machinery, household assets etc. are the other important assets. The different types of assets owned by sample households are reported in Tables 2.11 to 2.13. On an average a sample household reported to own 26.1 bigha of land of which 16.5 bigha as un-irrigated and 9.6 bigha as irrigated land (Table 2.11) and valued as 12.3 lacs.

**Table 2.11: Area owned by sample households** (in Bigha)

| Village | Total land | Irrigated | Un Irrigated | Land value |
|---|---|---|---|---|
| Balapura | 17.0 | 5.3 | 11.7 | 594125 |
| Laporiya | 30.8 | 5.0 | 25.8 | 1694000 |
| Maadpur | 13.0 | 7.1 | 5.9 | 455000 |
| Rahalana | 44.7 | 27.1 | 17.6 | 2458500 |
| Sailsagar | 24.6 | 1.8 | 22.8 | 861875 |
| Total | 26.1 | 9.6 | 16.5 | 1227318 |

Source: Primary survey

Ninety eight percent of the sample households reported owning agricultural land which account for 70 percent of total assets owned by households. Agricultural assets, which include tractor and other implements and machinery, account for 15 percent, household assets 10.3 percent and livestock 4 percent only (Table 2.12).

**Table 2.12: Per household value of assets owned by sample households.**

**(Rupees)**

| Village | Land | Agricultural assets | House hold assets | Livestock | Total Assets |
|---|---|---|---|---|---|
| Balapura | 594125 (48.0) | 374500 (30.3) | 155290 (12.5) | 113700 (9.2) | 1237615 (100.0) |
| Laporiya | 1694000 (71.5) | 324750 (13.7) | 233010 (9.8) | 116200 (4.9) | 2367960 (100.0) |
| Maadpur | 455000 (63.7) | 99900 (14.0) | 128650.3 (18.0) | 30950 (4.3) | 714500.3 (100.0) |
| Rahalana | 2458500 (78.6) | 375650 (12.0) | 234145 (7.5) | 58000 (1.9) | 3126295 (100.0) |
| Sailsagar | 861875 (72.4) | 126100 (10.6) | 147750 (12.4) | 55250 (4.6) | 1190975 (100.0) |
| Overall | 1227318 (70.1) | 265766.7 (15.2) | 181103.2 (10.3) | 75635.42 (4.3) | 1749823 (100.0) |

Source: Primary survey

*figures in parenthesis are percentage of gross total

The livestock owned and its composition is reported in Table 2.13. Small ruminants, i.e., sheep and goats account for 71 percent, cattle 18.3 percent, and buffalos 10.4 percent of the total livestock owned per household by the sample villages. If the total number of livestock is standardized as Adult Cattle Unit (AUC) it comes out to be 6.7 AUC per household and the total value of animals as Rs. 75,635.

**Table 2.13: Type number and value of Livestock owned by sample households**

(Per house hold)

| Village | Cattle | Buffalo | Goat | Sheep | Total Livestock | Total ACU | Total value(Rs.) |
|---|---|---|---|---|---|---|---|
| Balapura | 4.0 (9.2) | 1.4 (3.2) | 2.8 (6.5) | 35.1 (81.1) | 43.3 (100.0) | 9.9 | 113700 |
| Laporiya | 1.6 (16.5) | 2.3 (23.7) | 1.8 (18.6) | 4.0 (41.2) | 9.7 (100.0) | 5.6 | 116200 |
| Maadpur | 1.5 (13.8) | 0.8 (7.3) | 2.3 (21.1) | 6.3 (57.8) | 10.9 (100.0) | 3.6 | 30950 |
| Rahalana | 4.4 (60.3) | 1.9 (26.0) | 1.0 (13.7) | 0.0 (0.0) | 7.3 (100.0) | 7.4 | 58000 |
| Sailsagar | 3.6 (38.2) | 2.3 (23.7) | 3.6 (38.2) | 0.0 (0.0) | 9.5 (100.0) | 7.4 | 55250 |
| Total | 3.0 (18.3) | 1.7 (10.4) | 2.3 (13.7) | 9.5 (57.6) | 16.4 (100.0) | 6.7 | 75635 |

Source: Primary survey

*figures in parenthesis are percentage of gross total

The significant observations emerging out of this chapter are as follows:

- The peoples' attitude, perception and motivation to manage village community resources changed from community ownership and management to privatization.
- The human population increased very fast causing pressure on all the natural resources. Likely future changes caused by environmental change are going to build further pressure on the natural resources in terms of their exploitation.
- The level of basic amenities in the villages may not be able to meet the changing needs of the fast growing population.
- Agriculture is the main source of livelihood of rural population and therefore change in agricultural risk because of climate variability or climate change is going to seriously affect the livelihood of people.
- As source of irrigation do not safeguard people against climate variability therefore climate change will further increase the risk.
- Historically evolved mixed farming systems by rural population to cope with and adapt to the climatic risk are no more viable solution, in the changed economic environment, i.e., from self sufficient closed village economy to outside dependent market economy, gives them new shocks and risks increases their vulnerability.

All the above listed factors are going to through new challenges to manage the natural and other resources in the rural India.

Given the above discussed physical, environmental and socio-economic context the GVNML's interventions to support rural population based on sustainable livelihood principles are discussed in the next chapters.

## CHAPTER III

# GVNML INTERVENTIONS AND OUTCOMES

**3.1** The IPCC Report 2007 predicts about climate change and its impact on Dry Regions and Drought Affected Regions as follows;

a) For dry regions at mid-latitude and in the dry tropical areas, some of which are water stressed: the predicted impact is decrease in annual average river run-off and water availability.

b) For Drought affected areas: there will be increase in the extent and frequency of heavy precipitation events.

Rajasthan is categorized both as Dry Region and Drought affected areas. If the above predictions are accepted then it is likely that in future Rajasthan State will receive less rainfall and the frequency and intensity of droughts is going to increase. Analysis of last 106 years of rainfall data reveals that 50 percent years were drought years and the intensity and frequency of occurrence is increasing. It is also known that the nature of climate change, besides change in large macro complex parameters, at micro level can be observed by picking up at least two important parameters, namely temperature and rainfall. Increase in average temperatures across the globe and also at micro level in Rajasthan is being observed. While in case of rainfall the observations confirms increase in its variability in occurrences across the globe (both cases of high rainfall and scarcity/droughts) and declining trend in the GVNML intervention areas. The observed changes in these parameters have definitely increased uncertainty and risk for the rural population in Rajasthan.

The impact of increase in temperature on water, land, agriculture, biomass, and social aspects, which directly affects the livelihoods of people in rural areas, as expected to be is shown in the box below.

**Box 1: Impact of change in Temperature**

| WATER | AGRICULTURE | SOCIAL |
|---|---|---|
| Evaporation losses ⇧<br>Water availability ⇩<br>Groundwater recharge ⇩<br>Groundwater exploitation ⇧ | Food insecurity<br>Fodder insecurity<br>Change in cropping pattern/system<br>Increase use of insecticides /pesticides<br>Change in livestock population | Livelihood insecurity ⇧<br>Diversification of occupation<br>Nonfarm Activity<br>Migration ⇧ |
| **LAND** | **BIOMASS** | |
| Soil moisture deplition<br>Soil erosion<br>Cgange in land use pattern | Productivity ⇩<br>Biodiversity ⇩<br>Ecosystem services ⇩ | |

The rise in temperature is going to affect both surface and ground water availability in terms of increase in scarcity, increase in evaporation losses, decline in groundwater recharge consequently more exploitation of groundwater resource, etc. People have to respond to these changes by adopting coping strategies/adaptation measures to either augment supply of water by creating new rainwater harvesting structures or manage demand for water, both in domestic and agricultural sector.

The expected impact of CC on agriculture will be on food and fodder security, cropping pattern, lifecycles of insect and pastes, and composition of livestock population. Peoples' responses are likely to be adjustment in cropping pattern, new combinations of crop, livestock, horticulture, medicinal plants, other types of tree plantations to evolve farming system, and developing new crop technologies to counter the likely shortages in food and fodder production. As rise in temperature will create favourable environment for

germination of insects and pastes affecting crop production there has to be increase in use of insecticides and pesticides resulting in some environmental problems.

The social impact of rise in temperature can be many folds. Increase in climatic risk will force farmers and other population in the rural areas to search for alternative livelihood options, particularly in the nonfarm sector. Farmers will try to diversify their cropping pattern from crop husbandry to livestock based, mix-farming system, horticulture, cultivation of high value crops, particularly medicinal plants, etc. As a last option people will draw a migration plan to move within or outside state for employment.

The biomass productivity, biodiversity and ecosystem services are likely to decline with the rise in temperatures.

The impact of increase in rainfall variability on land, water availability, biomass, livestock, livelihood of rural population, etc. will be complex and will depend on the nature of rainfall variability. Some of the broad impacts of change in rainfall variability are listed below.

**Box 2: Impact of increase in rainfall variability**

- Increase or decrease in rainfall affecting total availability of water
- Increase or decrease in the rainy days will through new challenges for rain water harvesting in small or large structures.
- Change in the nature of rainfall – wide spread to sporadic rainfall will increase agricultural risks and affect present cropping practices.
- Change in runoff
- Shift in time of seasonal rains – delayed or early rainfall will affect crop calendar.

Changes in environment, i.e., temperature and rainfall variability, ultimately affects the livelihoods of rural population and increases their vulnerability. Traditional wisdom/knowledge helped them so far to cope with the situation but presently besides change in natural environment there is change in social, political and economic

environment and rural population find it difficult to self manage or cope with the increased vulnerability. NGOs have been working in the rural areas to provide support to the marginalized people to reduce their vulnerability in more than one way. GVNML is actively working in the three districts of Rajasthan, namely, Jaipur, Tonk and Pali since 1987 and helping people in having sustainable livelihood. In the subsequent section the interventions made by GVNML to provide sustainable livelihoods are discussed in the context of climate change, i.e. how far the support provided by the NGO improved the resilience of people to face the climate change events and outcomes.

## 3.2 GVNML's INTERVENTIONS

The interventions can be grouped in five general categories based on Modified Sustainable Livelihood Model discussed in the Chapter I, namely, Natural, Physical, Social, Human Capital, Financial, and Political/legal Capital. GVNML has done hardly any work on Political /legal capital but has large number of activities covering all other categories. Interventions till 2009 are listed by these categories and are discussed below.

### 1 Activities in the area of Natural and Physical Capital

The following activities of GVNML are put under the category of Natural and Physical capital:

- Pasture Land development – Chauka System
- Soil Moisture conservation - Field Bunds
- Water Harnessing Structures
- Developing Eco Parks
- Organic Farming
- Afforestation
- Agriculture and Livestock Development

The expenditure incurred and/or in numbers the progress made by GVNML is reported in Table 3.1.

There are two aspects of each activity; first, physical works, those were related to land, water, biomass and livestock with the objective to improve the productivity of these

**Table 3.1: NRM - Physical Construction** (Up to 2009)

| Activity | Cumulative Total |
|---|---|
| Chauka Building (Hectares) | 1634 |
| Field Bunds (Bigha) | 17130 |
| Nada, Nadi (Number) | 359 |
| Kheli /Animal drinking water structure(No.) | 10 |
| Talab/ponds (No.) | 78 |
| Khulla Chidya Ghar (Eco Park) (Hectares) | 30 |
| Jungle Hall (No.) | 2 |
| Organic Fertilization (Hectares) | 325 |
| Plowing (Hectares) | 350 |
| Grass Seeding (Hectares) | 1600 |
| Vermin Composting (Kg.) | 21,200 |
| Garbage Pits (No.) | 2 |
| Wastewater Soak Pits(No.) | 15 |

Source: Annual Report 2008-2009, GVNML, Page No.6

resources by undertaking various measures. Second aspect is the larger objective behind each activity. The larger objective of all the activities was to address the increasing demand for these resources and provide sustainable livelihood to the rural population. Also these activities were part of different donor funded programs and therefore, objective(s) were well specified for each activity.

As the major expectation of rural population is to get addressed the vulnerability caused by; first, over exploited natural resources (land, water, vegetation), and second, climatic risks directly affecting their livelihood. Under each activity efforts were made to restore the productivity of natural resources and to improve resilience and strengthen the age old well tested adaptations strategies of the people. Most innovative intervention created by GVNML, for which they received many state and national level awards, is pasture land development through 'Chauka System'. This single activity could increase biomass supply, restore the village biodiversity, recharge the groundwater and provided fodder and food security to humans, all kinds of animals(domesticated and wild) and birds. Even in a low rainfall year grazing lands were very productive. This activity strongly supported the traditional adaptive strategy, i.e., adoption of mix farming system to address climatic risk, by ensuring fodder availability to livestock component in the system. Also livestock rearing became sustainable livelihood activity even in the drought years. There were evidences of decline in out migration of human and livestock

population after introduction of Chauka system in number of villages. The outcomes of each activity can be highlighted at length but the purpose here is to establish that all these interventions in NRM sector brought significant outcome in terms of enhancing resilience of people to cope with climate variability/change as reported in many publications of the GVNML and few of them are discussed in the subsequent sections.

## Natural Capital/Physical Capital

Technology development- **Pastureland -Chauka**


Construction of Chaukas in community lands

The other innovative intervention of GVNML in the area of agriculture sector is construction of field bunding on large scale by community participation and covert single season agricultural land into both seasons cropping land. There were years when kharif season crop failed yet with the field pond and the soil moisture created by the bunds farmer could get Rabi season crops.

## Water Harvesting Structures

Talab

Personal Nada

Water Harvesting Structures in series

Water Harvesting Structures in series

# Organic Farming

Wormy Compost

Organic Farming

# Agricultural Crops

Sesamum Crop

Bajra Crop

Rajaka in Summer

Wheat fields in Rabi crop season

## 2 Activities in the area of Social/Cultural Capital

The following activities of GVNML are put under the category of Social Capital;

- Formation of Village Development Committees/Gram Vikas Samiti
- Gwal Samiti
- Jan Chetna Padyatra
- Dhundar Ratan Award
- Training to VDC, SHG, Gawal Samiti Members
- VDC, SHG, Gawal Samiti Members Exposure Visit
- Camp and Training in Village
- Cultural Program for awareness generation
- Contact with Govt. Departments

The above listed activities are basically for seeking participation of all the section of society in a village. Jan Chetna Padyatra (Prakriti Pujan Yatra) is a unique feature of GVNML, which started in 1987 and continued even till know. Every year on a fixed lunar calendar date a inter village foot march of men and women together is organised in a traditional fashion. In a procession with band and traditional musical instruments people move from one village to other and organise meeting at the bank of water body and worship the traditional water body, trees, etc. and a colorful ritual is performed. The auspicious date (Dev Uthani Gayaras) was selected because from this date change in weather condition takes place, i.e., rainy season to winter season, and also traditionally known for worship of nature. People use to pay respect to natural resources and protect village ponds, trees, wildlife, etc. Through this activity a mass movement in around 150 villages was build to create awareness about protecting our environment and seek peoples' participation by committing to do some environment conservation activity, i.e., planting trees in house premises, in common lands, schools, near the water bodies, etc. and also take responsibility to protect them. Few people even commit to construct ponds/talabs or new water bodies to harness rain water. This movement has resulted in mass awareness among all age group of population and also influenced other NGOs. Some of the NGOs in the region have started the *yatra* (procession) as a tool to mobilize people and create social harmony. Such social mobilization facilitates planning community strategy to counter climatic risks. As it was observe that the social capital generated through this activity facilitated GVNML in taking up grazing land development at large scale in many villages/ districts without much conflict. All other activities also helped in creating hormonal relationship in the intervention villages. Most of the village

development or livelihood activities are taken up by Village Development Committee (VDC).

## Social/Cultural Capital

Pad Yatra

Kalash Yatra

Talab Pujan

Talab Pujan

Under Social Capital building activities village level and project based institutions/ groups were formed including thrift groups of women. Members of these groups mostly lack skills and capacity to perform the assigned roles and responsibilities. Hence capacity building programmes in the form of trainings, workshops, exposure visits, etc were planned to build required capacity of the people. These activities help people in improving their condition/position in the society and also in attaining sustainable livelihoods. In the climate variability/change context it helped in improving their resilience/ capacity to face the risks. Details about the activities are given in Table 3.2.

**Table 3.2: Capacity building activities** (up to 2007-2008)

| Particulars | Numbers | Participants |
|---|---|---|
| Training to VDC, SHG, Gawal Samiti Members | 43 | 1688 |
| VDC, SHG, Gawal Samiti Members Exposure Visit | 18 | 467 |
| Camp and Training in Village | 9 | 436 |
| Cultural Program for awareness generation | 8 | 1722 |
| Contact with Govt. Departments | 14 | 370 |
| Gawal Samiti Members | 2 | 120 |
| SHG Members | 2 | 86 |
| Farmers Training | 2 | 110 |
| Exposure Visit | 2 | 65 |
| VDC Members | 3 | 157 |
| VDC members and Govt. officers | 1 | 40 |

Source: Annual Report 2007-2008, GVNML, Page No.9

## 3 Activities in the area of Human Capital Development.

The following activities, undertaken by GVNML under different programs/projects, are categorized under the heading Human Capital.

- Health and Sanitation
- Education
- Women Empowerment
- Food and Nutrition
- Child Development Program
- Trainings

Generally in poor State there is lack of basic amenities in rural areas and Rajasthan is no exception. Most of NGOs in Rajasthan helped in providing basic amenities in areas

which were less attended by the state government sectoral departments, particularly tribal areas, scattered settled population in desert districts and also pockets in the semi-arid areas. GVNML also provided some of the basic services or made people capable of availing the available government basic services in the areas of health and sanitation, education, food and nutrition, child development, etc. The activities and achievements till 2009 are reported in Table 3.3.

**Table 3.3: Maternal & Children's health** (Up to 2009)

| Activity | Cumulative Total |
|---|---|
| Dai Training (No.) | 1988 |
| Vaccination & Supplements Program (Population) | 100% tetanus, 62% Iron tablets |
| Nutritional Food Distribution (Families) | 23103 |
| Baby Weight Monitoring (No.) | 19370 |
| Birth Registration Children (No.) | 55946 |
| At-home Medical Checkups (No.) | 23103 |
| Hand Pump Water Quality Check (Villages) | 130 |

Source: Annual Report 2008-2009, GVNML, Page No.13

The above listed human capital formation activities helped the poor and marginal section of the population in building their capacity to live better quality of life and in turn build their resilience to face natural calamities.

All these above interventions listed and discussed in the four sustainable livelihood categories are documented in various annual reports published by the GVNML and in respective programme/ project reports and therefore detail activity report is avoided in this document. However, the outcome of these activities is discussed in the next section.

## Human Capital

VDC

Women Empowerment

Child Development

Gwal Samiti

## 3.3 IMPACTS OF GVNML's INTERVENTIONS

As discussed above the GVNML made numerous intervention in the last say two decade in an around 300 villages in Jaipur, Tonk and Pali districts. These interventions were largely in the sustainable livelihood framework. The outcome of these interventions is generally visible to anybody who visits the GVNML villages. However we have tried to show the impacts by using secondary data set for that period of three districts and also village and household level primary data by undertaking quick surveys in 5 sample villages. Given the limitation of time and scope of study in depth impact study was not carried out. The purpose of using secondary data of the districts for two time period, i.e., 1990 (when the GVNML started the work) and 2005 (year for which latest data available) is to show the overall changes because of the government's economic development polices and other socio-economic changes. While the results from village and household survey helps isolating changes because of GVNML interventions.

The impact of GVNML interventions are studied on mainly land, water, agriculture and to some level on livelihoods and are discussed below:

### 3.3.1 Land use

Change in land use pattern of three districts namely Jaipur, Tonk, and Pali is reported in the Table 3.4. The table shows that area under forests has slightly increased in Pali and Tonk districts and relatively more in Jaipur District. It may be partly due to the afforestation efforts of the State and partly setting the boundaries of forest areas rectified by removing encroachments.

The area under the category Land put to non-agricultural use has increased in all the three districts while the area under Barren and uncultivated land is declining. Unfortunately the category of land called 'Not available for Cultivation' is mostly miss treated by both the State and the people, not realizing their role in providing ecosystem services and therefore the first victim of any developmental works initiated by Panchayat or State.

Permanent pasture lands are shrinking in the Jaipur and Tonk districts while in Pali they are being protected may be from either encroachment or allotments for various anti environment activities, i.e., mining and quarrying, etc.

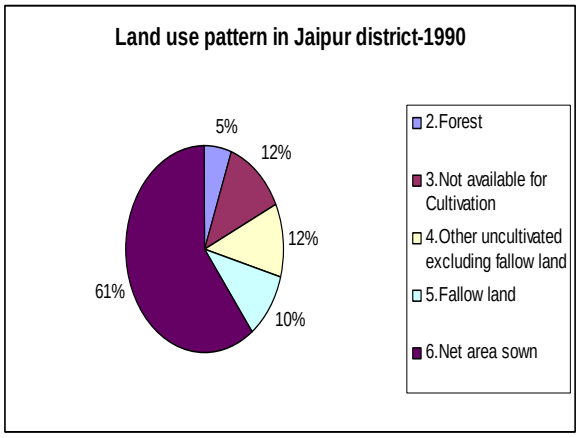
**Table 3.4: Change in Land use pattern in Pali, Jaipur, and Tonk districts in Rajasthan.** (Figures in percentages)

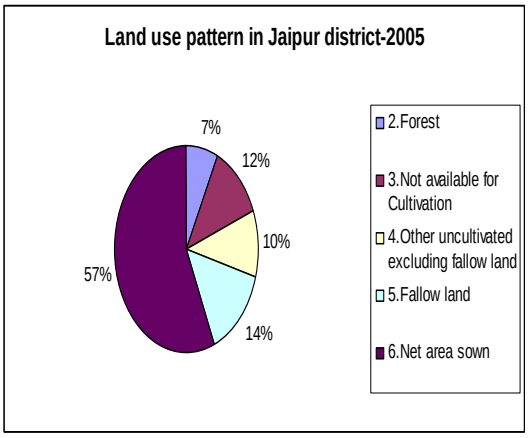
| **Districts** | **Pali** | | **Jaipur** | | **Tonk** | |
|---|---|---|---|---|---|---|
| **Land category** | 1990 | 2005 | 1990 | 2005 | 1990 | 2005 |
| 1.Geographical Area according to Village papers | 100.0 (1233.1) | 100.0 (1233.1) | 100 (1399.1) | 100 (1105.6) | 100 (718.1) | 100 (717.9) |
| 2.Forest | 6.28 | 6.65 | 5.45 | 7.33 | 3.36 | 3.79 |
| 3.Not available for Cultivation | | | | | | |
| (A)Land put to non agricultural use | 4.57 | 4.73 | 5.82 | 6.94 | 4.84 | 6.68 |
| (B)Barren & uncultivated | 12.14 | 11.67 | 6.66 | 4.92 | 4.94 | 3.89 |
| Total(A+B) | 16.71 | 16.40 | 12.48 | 11.86 | 9.78 | 10.57 |
| 4.Other uncultivated excluding fallow land | | | | | | |
| (C)Permanent pasture & other grazing land | 7.35 | 7.37 | 7.50 | 6.96 | 8.41 | 5.96 |
| (D)Land under misc. tree crops & groves not included in net area sown | 0.09 | 0.01 | 0.14 | 0.08 | 0.06 | 0.02 |
| (E)Culturable waste | 3.17 | 3.71 | 3.95 | 3.09 | 6.05 | 6.02 |
| Total(C+D+E) | 10.61 | 11.09 | 11.59 | 10.13 | 14.52 | 12.00 |
| 5.Fallow land | | | | | | |
| (F)Old fallow land | 8.21 | 9.88 | 5.13 | 5.51 | 2.55 | 3.78 |
| (G)Current fallow land | 6.40 | 6.71 | 5.15 | 8.89 | 3.99 | 3.66 |
| Total(F+G) | 14.60 | 16.59 | 10.28 | 14.40 | 6.54 | 7.45 |
| 6.Net area sown | 51.79 | 49.27 | 60.21 | 56.28 | 65.80 | 66.19 |
| 7.Total cropped area | 58.76 | 53.32 | 78.41 | 89.50 | 72.69 | 85.20 |
| 8.Area sown more than once | 13.45 | 8.22 | 30.24 | 59.05 | 10.46 | 28.72 |

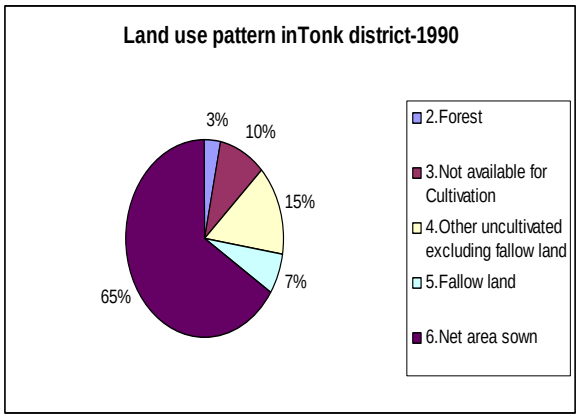
Note: figures in parenthesis are in thousand hectares

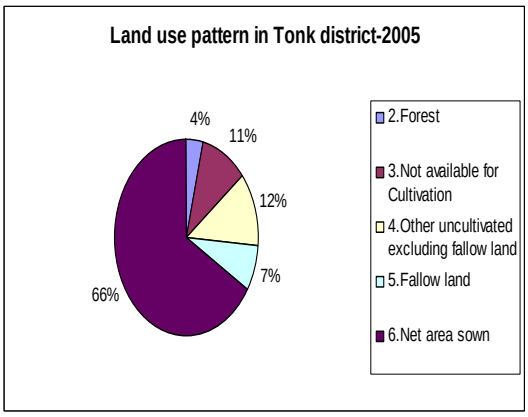
Area under land use categories Old Fallow and Current Fallow lands are increasing. Net area sown is declining while 'Area Sown More than Once' is increasing. It shows that

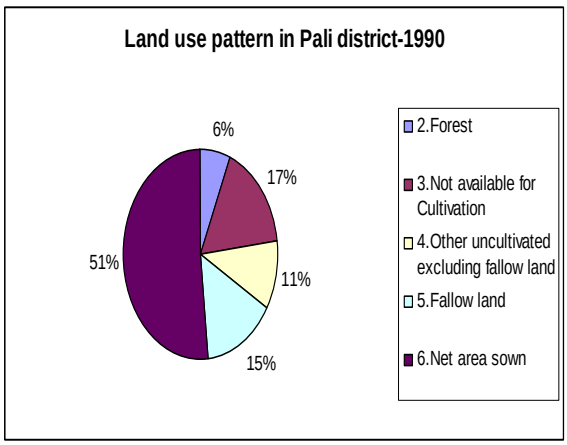
cropping intensity is increasing and if soil nutrients are not managed properly health of the soils is going to be affected. Figures shown below also show the changes.

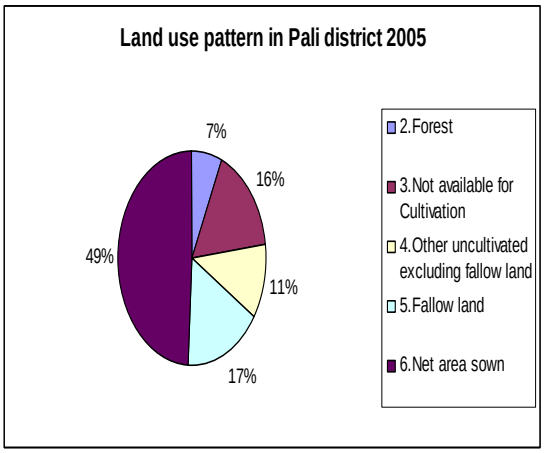


### 3.3.2 Agriculture

Change in cropping pattern in the three GVNML work districts is shown in figures below. The figures provides details percentage share of area of crops grown in Rabi and Kharif seasons in the three districts for the years 1992 and 2006. These figures shows the change in cropping pattern because of the cumulative changes caused by change in rainfall, temperature and other environmental variables, change in relative prices of agricultural commodities, technological development, etc.etc. This general information will compared with the ground level changes in the sample villages in the next section and try to find out how much of this was the contribution of GVNML.

The broad common changes in the allocation of area under Kharif and Rabi crops in Jaipur, Tonk and Pali are as follows:

*Kharif Season*

a) Area under kharif pulses is increasing.
b) Area under major Corse grains namely, Bajra, Jowar and Maize is declining.
c) Number of crops grown is reducing, i.e., crop bio-diversity is reducing.
d) Area under groundnut in Jaipur district is increasing.

These changes reflects that the variability/ uncertainty in rainfall is increasing and because of that regular kharif crops cannot be sown and late sowing crops such as pulses are sown. Secondly, reduction in number of crops and their varieties is not good from environment and health point of views.

*Rabi Season*

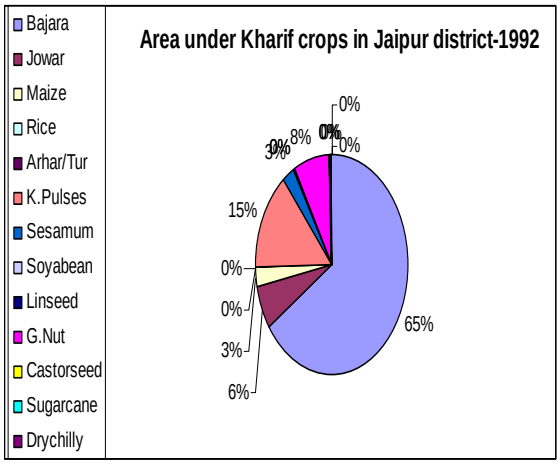
a) Area under wheat crop is increasing in Jaipur and Pali district and declining in Tonk district.
b) Mustard the major oilseed crop grown in *Rabi* season, its area is increasing in Tonk district declining in Pali and constant in Jaipur district.
c) The major *rabi* pulse crop namely Gram is losing area in Jaipur gaining in Pali and not important in Tonk district.
d) Barley a traditional rabi crop of Rajasthan is picking up in Jaipur district.
e) Number of crops grown is very limited in rabi season.

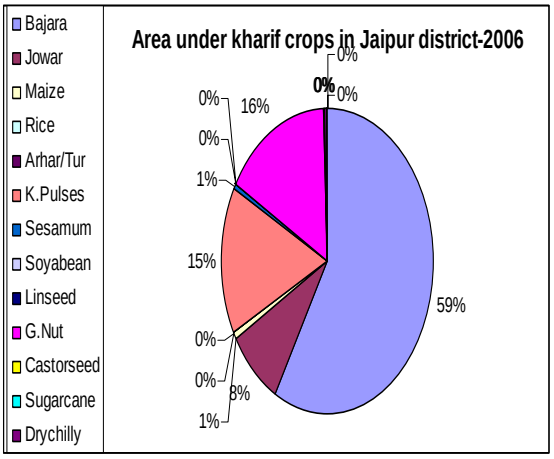
Rabi season crops are mostly irrigated crops and their area is constrained by source of irrigation. Source wise irrigation is shown in the figures below. Groundwater as source of

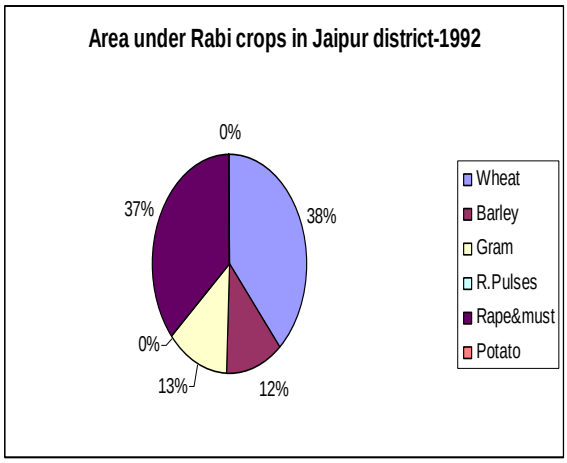
irrigation accounted for 100, 74, and 72 percent in Jaipur, Tonk and Pali districts respectively in 1992 and is declining. Groundwater over exploitation is very high in Rajasthan and is evident in all the three districts as in Tonk the share of groundwater declined from 74 percent in 1992 to 57 percent in 2006. Surface water irrigation thorough canals, tanks and traditional sources provided irrigation to 18 percent in Tonk and 29 percent in Pali in 1992 and the share has increased in Tonk district as the groundwater declined. In such conditions Rabi crops cultivation practices are changing by shift from water intensive crops to low water demanding such as mustard and gram and changing irrigation technology by use of sprinklers and drips. This is also evedient from the Table 3.5.

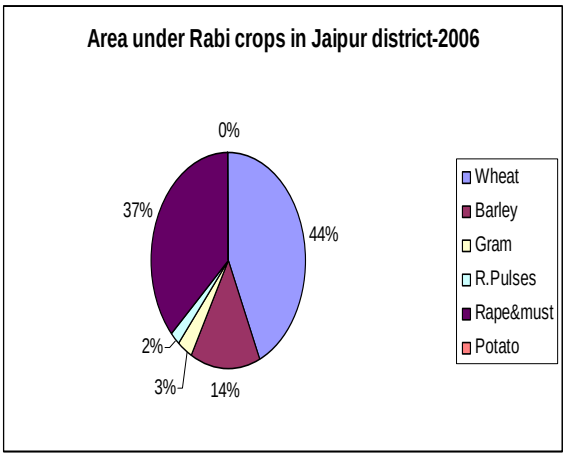
**Table 3.5: Change in Depth of groundwater level in GVNML area.**

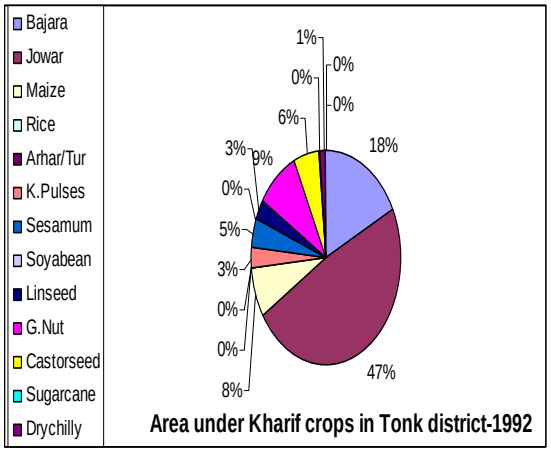
| Average water level(m) | Dudu | Phagi | Malpura |
|---|---|---|---|
| 1984 | 10.35 | 10.03 | |
| 1996 | 13.97 | 12.17 | 4.51 |
| 2001 | 15.87 | 13.03 | 7.98 |
| 2006 | 19.98 | 17.40 | 12.49 |
| Cato gory | Critical | Critical | Semi Critical |

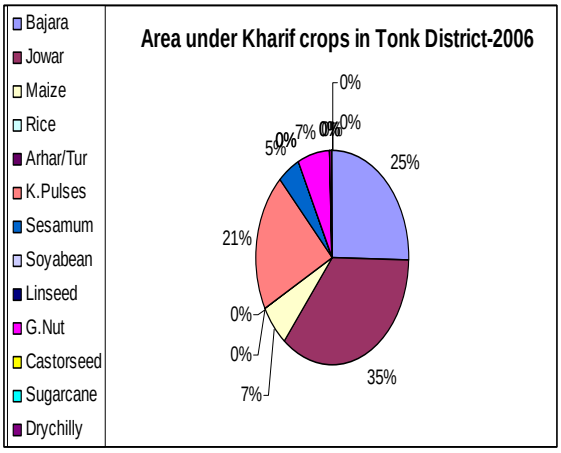


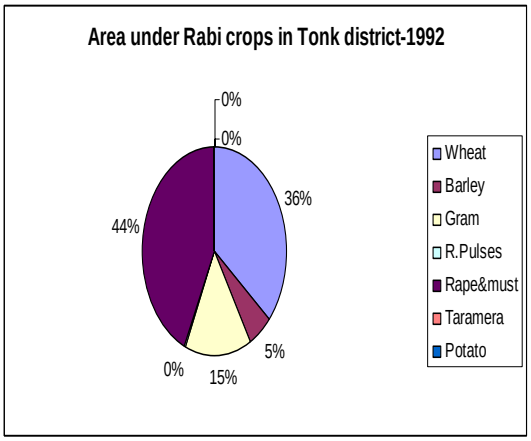



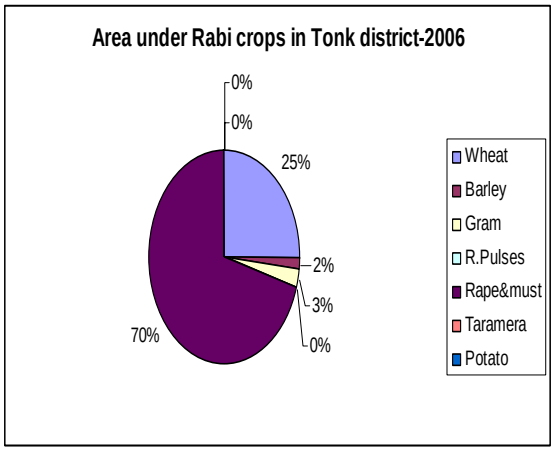

Area under Rabi crops in Jaipur district-1992
0%
37%
38%
0%
13%
12%
Wheat
Barley
Gram
R.Pulses
Rape&must
Potato

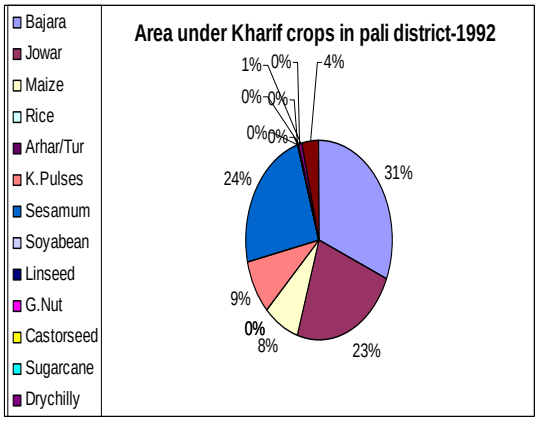

Area under Rabi crops in Jaipur district-2006
0%
37%
44%
2%
3%
14%
Wheat
Barley
Gram
R.Pulses
Rape&must
Potato

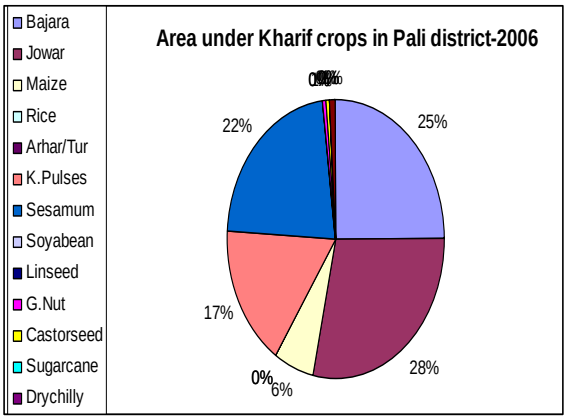

Bajara
Jowar
Maize
Rice
Arhar/Tur
K.Pulses
Sesamum
Soyabean
Linseed
G.Nut
Castorseed
Sugarcane
Drychilly
1%
0%
0%
6%
3%
9%
18%
0%
5%
3%
0%
0%
8%
47%
Area under Kharif crops in Tonk district-1992

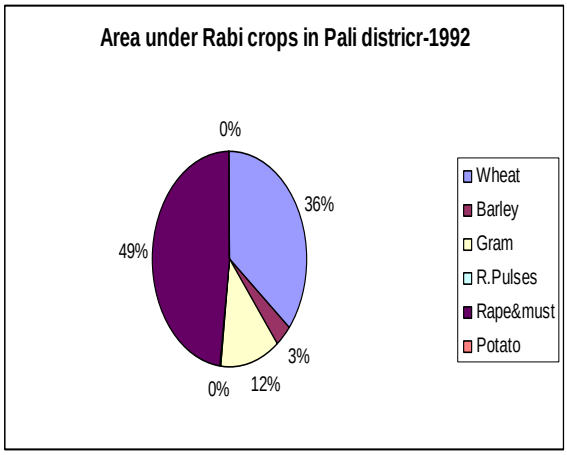

Bajara
Jowar
Maize
Rice
Arhar/Tur
K.Pulses
Sesamum
Soyabean
Linseed
G.Nut
Castorseed
Sugarcane
Drychilly
Area under Kharif crops in Tonk District-2006
0%
0%
7%
5%
25%
21%
0%
0%
7%
35%

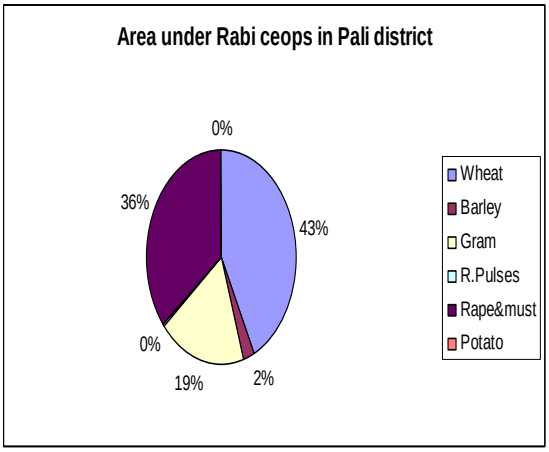

Area under Rabi crops in Tonk district-1992
0%
0%
36%
44%
5%
0%
15%
Wheat
Barley
Gram
R.Pulses
Rape&must
Taramera
Potato


Area under Rabi crops in Tonk district-2006
0%
0%
25%
2%
3%
70%
0%
Wheat
Barley
Gram
R.Pulses
Rape&must
Taramera
Potato


Area under Kharif crops in pali district-1992
Bajara
Jowar
Maize
Rice
Arhar/Tur
K.Pulses
Sesamum
Soyabean
Linseed
G.Nut
Castorseed
Sugarcane
Drychilly
1%
0%
4%
0%
0%
0%
0%
24%
31%
9%
0%
8%
23%


Area under Kharif crops in Pali district-2006
Bajara
Jowar
Maize
Rice
Arhar/Tur
K.Pulses
Sesamum
Soyabean
Linseed
G.Nut
Castorseed
Sugarcane
Drychilly
22%
25%
17%
0%
6%
28%


Area under Rabi crops in Pali districr-1992
0%
36%
49%
3%
0%
12%
Wheat
Barley
Gram
R.Pulses
Rape&must
Potato


Area under Rabi ceops in Pali district
0%
36%
43%
0%
19%
2%
Wheat
Barley
Gram
R.Pulses
Rape&must
Potato

Irrigation Sources: Area irrigated by tanks & bunds in 1990 and 2006 is reported in Table 3.6. The table shows that wells and tube wells are the main source of irrigation in all the three districts. In Pali district tanks irrigate 28 per cent of land. In Tonk district Tank use to contribute 7.1 percent of irrigation in 1990 and that share has declined. It is well known that groundwater has been overexploited in Rajasthan and because of that area irrigated by wells and tube wells is declining all over and it is also reflected in case of these three GVNML districts. In case of Jaipur district the share has increased because of increase in the number of tube wells in last 10 years adding more area under irrigation.

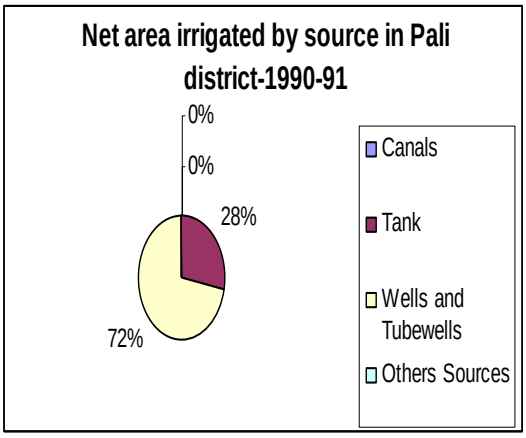
**Table 3.6: Net Irrigated area by source in GVNML Districts (1990, 2006)**

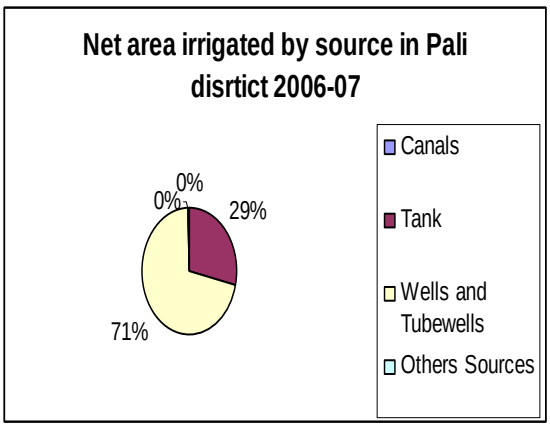
(Percentages)

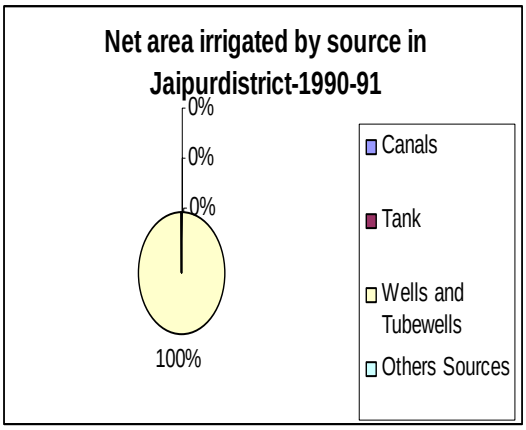
| Sources | Pali | | Jaipur | | Tonk | |
|---|---|---|---|---|---|---|
| | 1990 | 2006 | 1990 | 2006 | 1990 | 2006 |
| Canals | 0.0 | 0.0 | 0.3 | 0.3 | 18.2 | 37.6 |
| Tank | 28.0 | 28.6 | 0.2 | 0.0 | 7.1 | 0.4 |
| Wells and Tube wells | 72.0 | 71.0 | 99.5 | 99.7 | 73.6 | 56.8 |
| Others Sources | 0.0 | 0.4 | Neg. | 0.0 | 1.1 | 5.2 |
| Net Area irrigated | 100.0 (166219) | 100.0 (151225) | 100.0 (348827) | 100.0 (299198) | 100.0 (86219) | 100.0 (196446) |

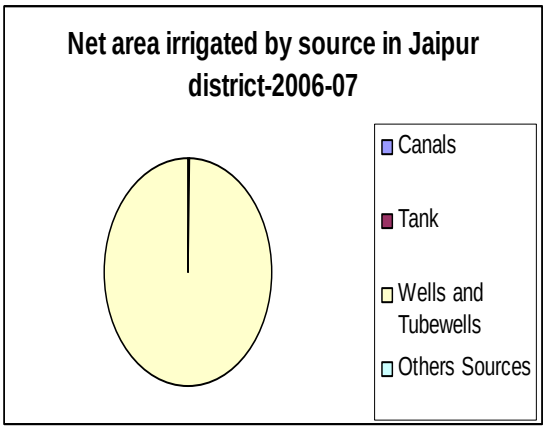
Note: Figures in parenthesis are numbers

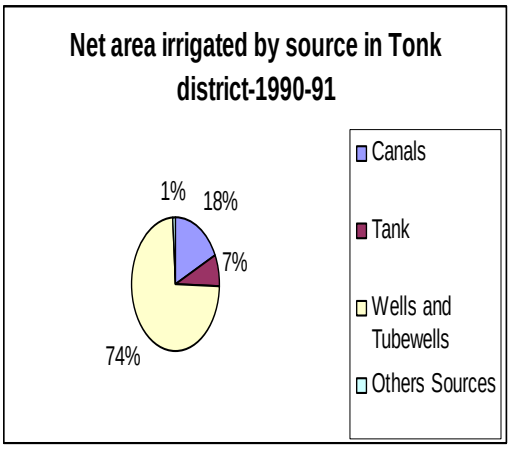
Tanks and bunds provide an alternative source to wells for irrigation in the most part of the Pali district, more so in Pali and Bali tehsils, where they provide irrigation to 16% and 14% of the Irrigated area respectively in 1966-67. There no natural tanks but embankments are found in most villages accept in Jaitaran Tehsil. Tanks and bunds have been constructed to utilize the water of Luni River and its four tributaries. Wells are the most important source of drinking and irrigation in the district because of the precarious and scanty nature of rainfall. They exist in large numbers in all part of district and provide water to nearly 73 percent of the net area irrigated (1970-71).

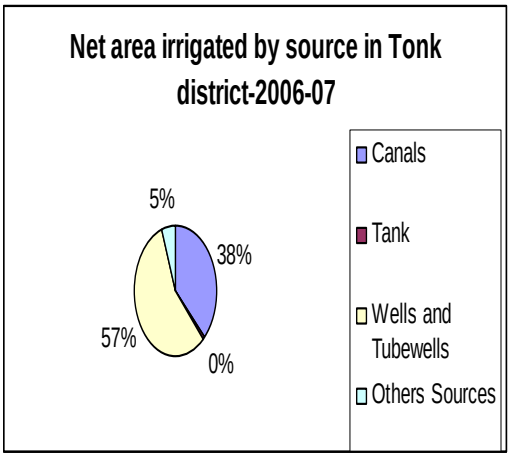

Net area irrigated by source in Pali district-1990-91
0%
0%
28%
72%
Canals
Tank
Wells and Tubewells
Others Sources


Net area irrigated by source in Pali disrtict 2006-07
0%
0%
29%
71%
Canals
Tank
Wells and Tubewells
Others Sources


Net area irrigated by source in Jaipurdistrict-1990-91
0%
0%
0%
100%
Canals
Tank
Wells and Tubewells
Others Sources


Net area irrigated by source in Jaipur district-2006-07
Canals
Tank
Wells and Tubewells
Others Sources


Net area irrigated by source in Tonk district-1990-91
1%
18%
7%
74%
Canals
Tank
Wells and Tubewells
Others Sources

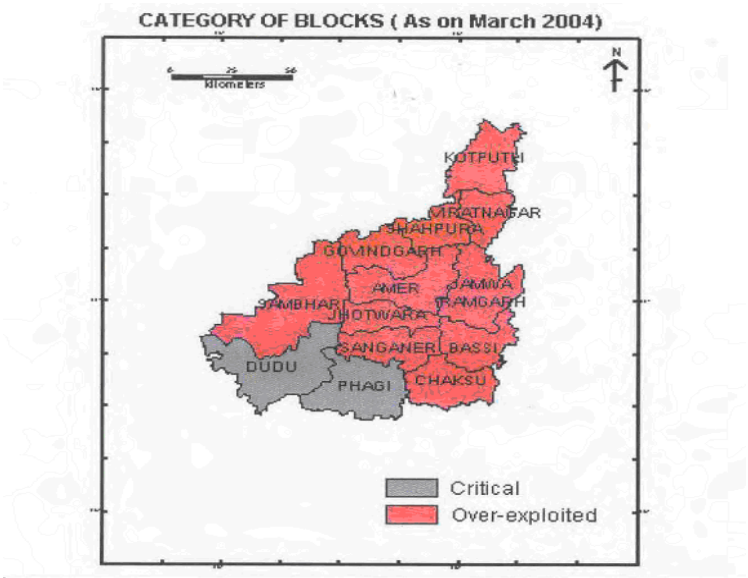

Net area irrigated by source in Tonk district-2006-07
5%
38%
57%
0%
Canals
Tank
Wells and Tubewells
Others Sources

### 3.3.3 Status of Groundwater

Groundwater, which is major source of drinking water and irrigation supply in rural areas, plays important role in mitigation/ coping the adverse impact of climatic risk. Over exploitation of this resource has reduced the resilience of people and adversely affected their livelihood.

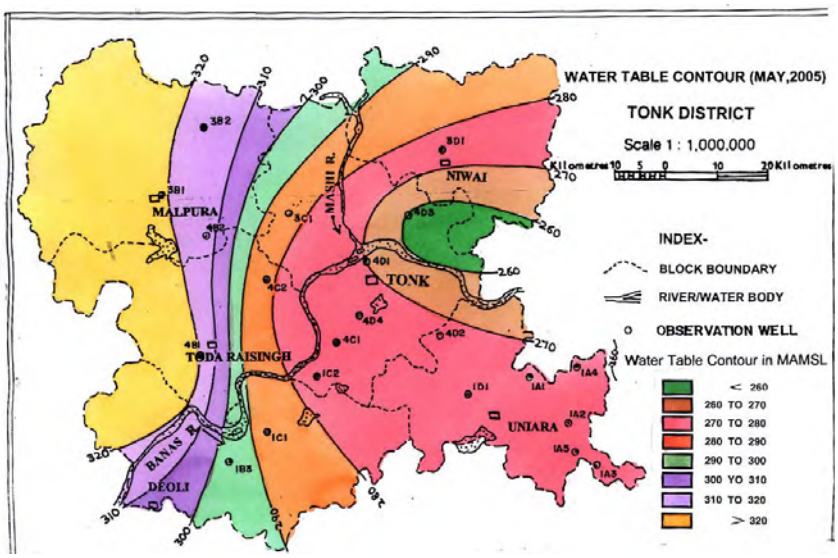
The status of groundwater as reported by Central Ground Water Board and State Ground Water Department in their District wise groundwater reports is as follows;

*In Jaipur District*: Groundwater resources being dynamic in nature, the depth to water level keep on changing seasonally, annually and on long term basis depending on recharge –discharge balance. Depth to water level in the district during pre-monsoon 2006 ranges from minimum of 10.30 at Sewa in Dudu district to deepest at 70.20 m at Chomu in Govindgarh block. Depth to water level in most part of northern block areas (i.e. parts of Shahpura, Kotputli, Bairath), eastern part in Jamwa Ramgarh block and southern parts (parts of Chaksu, Phagi, Dudu & Sambhar) is less than 25m. Over-exploitation of groundwater resources have set declining trend in water levels. Even average Premonsoon-Postmonsoon water levels show decline in most of the blocks indicating significant withdrawal as compared to natural recharge to groundwater. The category of groundwater blocks in Jaipur district is shown in the figure below. Dudu and Phagi are the only blocks in entire district in critical stage rest all are in over exploited stage. These two blocks are the GVNML intervention areas.




Source: CGWB and SGWD, District wise GW Status Reports.

*Tonk District*: Increase in ground water exploitation has resulted in declining trend in water levels magnitude of which ranges from 0.035 m/yr at Devali to 1.187m/yr at Malpura over a period of last 10 years. The stage of ground water development for the district as a whole is 96.39%. Out of 6 blocks of Tonk District, 1 block (Uniara) is categorized as "Over -exploited" and remaining 5 blocks (Deoli, Malpura, Niwai, Toda Raisingh and Tonk) are categories as "Critical". Again the Malpura block is the GVNML intervention area.




Source: CGWB and SGWD, District wise GW Status Reports.

## 3.4 Sample Survey Results

The above findings were based on secondary data for the selected districts. In this section results from the primary survey conducted in the five sample villages in three districts of Rajasthan, where GVNML made interventions since 1987, are discussed. The objective is to highlight the impact caused by GVNML interventions on the livelihoods of people and how far those interventions helped building resilience of people to face climate variability/ change.

The activities undertaken to improve the productivity of natural resources, namely, land, water and biomass had resulted in increase in the income of beneficiaries. In case of land related activities (as listed above), both private and community land were treated. The most prominent activities, i.e., Meid Bandi on private lands and Chauka System on community land, helped in groundwater recharge leading to increase in agricultural income and increase in availability of fodder and fuel. Table 3.7 shows per household source wise income of sample households.

Table 3.7: Per household source wise income of sample households

| Village | Balapura | Laporiya | Maadpur | Rahalana | Sailsagar | Total |
|---|---|---|---|---|---|---|
| Cultivation Income | 98340 (56.0) | 38500 (40.2) | 13920 (21.6) | 18210 (36.7) | 70420 (56.1) | 46938.75 (46.4) |
| Agriculture Labour | 4500 (2.6) | 5000 (5.2) | 7300 (11.3) | 0 (0.0) | 6250 (5.0) | 4541.667 (4.5) |
| Non Agriculture Labour | 14600 (8.3) | 14050 (14.7) | 18360 (28.5) | 7000 (14.1) | 12562.5 (10.0) | 13345.83 (13.2) |
| Artesian income | 0 (0.0) | 1000 (1.0) | 4600 (7.1) | 3567 (7.2) | 0 (0.0) | 1909.792 (1.9) |
| Businesses Income | 0 (0.0) | 0 (0.0) | 4300 (6.7) | 2500 (5.0) | 2500 (2.0) | 1833.333 (1.8) |
| Other income | 6000 (3.4) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 1000 (0.8) | 1416.667 (1.4) |
| Total income | 123440 (70.3) | 58550 (61.1) | 48480 (75.3) | 31277 (63.0) | 92732.5 (73.9) | 69986.04 (69.1) |
| Total Income from CPR | 52250 (29.7) | 37280 (38.9) | 15933 (24.7) | 18358 (37.0) | 32757.5 (26.1) | 31255.63 (30.9) |
| Gross income of household | 175690 (100.0) | 95830 (100.0) | 64413 (100.0) | 49635 (100.0) | 125490 (100.0) | 101241.7 (100.0) |

Source: Primary survey
*figures in parenthesis are percentage of gross total

It is interesting to note that before interventions the Community Lands were in bad shape and except sheep grazing there was hardly any income from these lands. After the introduction of Chauka system the same community lands started contributing between 25 to 39 percent in the household income amounting to Rs. 31255 as shown in the Table 3.7. The breakup of this income received from community lands is shown in Table 3.8. Before GVNML interventions there was shortage of firewood and fodder in the villages and now not only the village demand for these items are met, these lands are also providing an item called Ker(see photograph below), used as vegetable and pickle. The other significant contribution of these lands was that rejuvenation of biodiversity in the villages. Large number of grass, trees, bushes and medicinal plant species got regenerated. Even in the drought year these grazing lands could sustain livestock, particularly the small ruminants (Sheep and Goats).

**Table 3.8: Per household Income from CPR's in sample villages.**

(In Rupees)

| Village | Firewood | Fodder | Vegetable | Employment | Total Income |
|---|---|---|---|---|---|
| Balapura | 20250.0 (38.8) | 24840.0 (47.5) | 1640.0 (3.1) | 5520.0 (10.6) | 52250.0 (100.0) |
| Laporiya | 11750.0 (31.5) | 19800.0 (53.1) | 210.0 (0.6) | 5520.0 (14.8) | 37280.0 (100.0) |
| Maadpur | 5500.0 (34.5) | 5300.0 (33.3) | 165.0 (1.0) | 4968.0 (31.2) | 15933.0 (100.0) |
| Rahalana | 5200.0 (28.3) | 7500.0 (40.9) | 690.0 (3.8) | 4968.0 (27.1) | 18358.0 (100.00 |
| Sailsagar | 13125.0 (40.1) | 13125.0 (40.1) | 987.5 (3.0) | 5520.0 (16.9) | 32757.5 (100.0) |
| Overall | 11083.3 (35.5) | 14154.2 (45.3) | 728.1 (2.3) | 5290.0 (16.9) | 31255.6 (100.0) |

Source: Primary survey
*figures in parenthesis are percentage of gross total

The contribution of community lands in quantity terms is reported in Table 3.9.

**Table 3.9: Per household quantity of products and employment received from CPR's.** (in quintals/days)

| Village | Firewood | Fodder | Vegetable (Ker) | Employment (Man days) |
|---|---|---|---|---|
| Balapura | 76.5 | 91.5 | 0.8 | 5.1 |
| Laporiya | 24.1 | 40.0 | 0.1 | 5.1 |
| Maadpur | 10.5 | 17.0 | 0.1 | 4.6 |
| Rahalana | 12.0 | 26.0 | 0.2 | 4.6 |
| Sailsagar | 26.3 | 42.5 | 0.3 | 5.1 |

Source: Primary survey
*figures in parenthesis are percentage of gross total

The other important intervention namely development of Eco Park in the pasture/grazing lands by putting up an enclosure on a piece of land with no entry and leave the area for regeneration of flora and fauna. Initially some seeds of grass and plantation of trees was undertaken and then social fencing was ensured by the village community. This is a unique intervention in terms of changing the mind set of people, from exploitation of resources to conservation, and also regeneration and conservation of biodiversity, so far it has worked successfully.

## Developing Eco Park's



## Impact of Afforestation on Pasture and Community Lands

Ker plants in pasture lands

*Impact on Groundwater*: The work undertaken on community lands and private land also helped in recharging of dug wells in the villages and those became source of irrigation as shown in the Table 3.10. Villages that got converted from double crop irrigated agriculture to single crop

rainfed were reverted back by GVNML interventions and helped households in attaining food security.

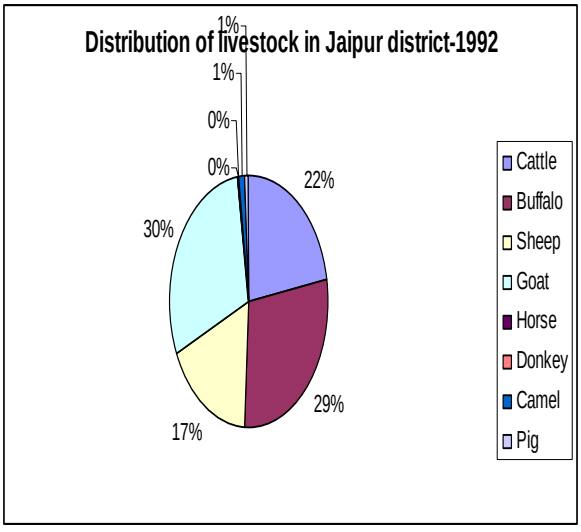
**Table 3.10: Source of Irrigation with sample households** (Percentages)

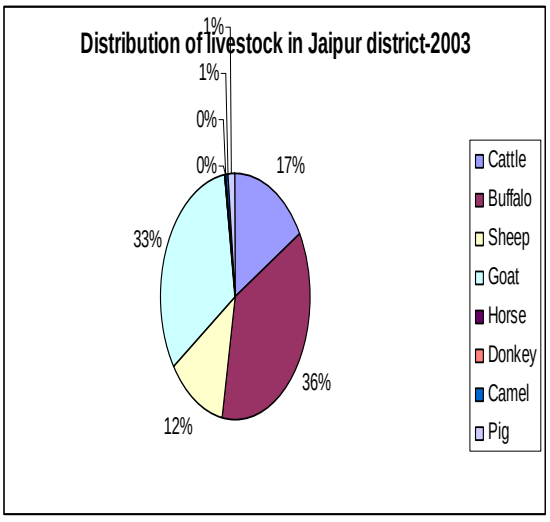
| Village | No source | Well | Canal | Well/Canal/ Nada | Total |
|---|---|---|---|---|---|
| Balapura | 10 | 0 | 10 | 80 | 100 |
| Laporiya | 10 | 90 | 0 | 0 | 100 |
| Maadpur | 30 | 70 | 0 | 0 | 100 |
| Rahalana | 30 | 70 | 0 | 0 | 100 |
| Sailsagar | 38 | 25 | 12 | 25 | 100 |
| Total | 23 | 52 | 4 | 21 | 100 |

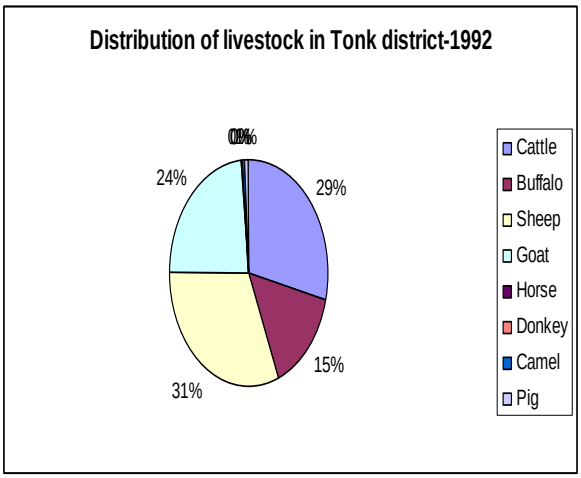
Source: Primary survey

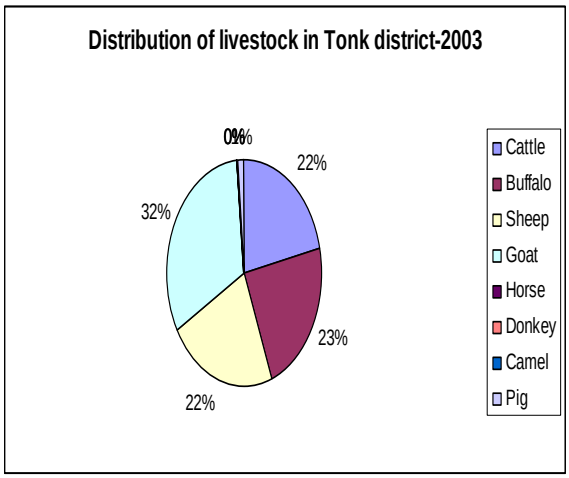
### 3.4.1 Impact on Livestock

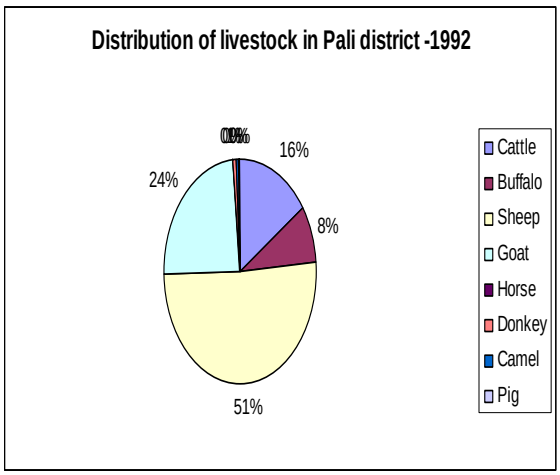
The composition of livestock also changed in the intervention village because of secured fodder availability from farm and community lands as shown in the two diagrams. The number of cattle and sheep declined while the number of goats and buffaloes increased. Goat has ready meat market and buffaloes have milk market. It was reported by the sample households that assured fodder supply helped in setting up of dairy in villages. Even in the drought years thousand of liters of milk were collected from the village by the Rajasthan Dairy Federation. GVNML interventions helped people to cope with drought and climate variability.

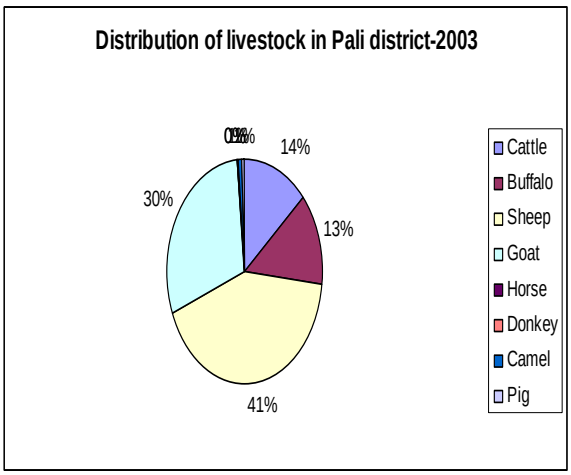



Distribution of livestock in Tonk district-1992
24%
29%
15%
31%
Cattle
Buffalo
Sheep
Goat
Horse
Donkey
Camel
Pig


Distribution of livestock in Tonk district-2003
22%
32%
23%
22%
Cattle
Buffalo
Sheep
Goat
Horse
Donkey
Camel
Pig


Distribution of livestock in Pali district -1992
16%
24%
8%
51%
Cattle
Buffalo
Sheep
Goat
Horse
Donkey
Camel
Pig


Distribution of livestock in Pali district-2003
14%
30%
13%
41%
Cattle
Buffalo
Sheep
Goat
Horse
Donkey
Camel
Pig

# Livestock

Cattle

Cattle milking


Buffalo Grazing

Alternate Grazing -Sheep

# CHAPTER IV
# CONCLUSIONS

The National Action Plan on Climate Change (NAPCC) recognizes that climate change will seriously affect and alter the distribution, type and quality of natural resources of the country and associated livelihoods of the people. Policy makers and researchers have identified a number of measures to reduce adverse impacts of climate change. Some of the interventions more contextual to this study are:

a) Enhancing carbon sinks in sustainably managed forests and other ecosystems.
b) Improving observation, forecasting and early warning systems.
c) Establishing hazard and vulnerability mapping.
d) Fostering community involvement and awareness raising.
e) Improving operation and maintenance of existing water infrastructure.
f) Improving irrigation efficiency.
g) Developing varieties of crops and livestock with greater resilience to limited arable land and extreme conditions.
h) Creating community-based forest management and afforestation projects.
i) Improve inter-departmental coordination.
j) Enabling adaptations of local communities in the face of climatic variability.
k) Enhancing the resilience and ability of vulnerable species/ecosystems to adapt to the changing climate.

All these measures find place in the macro plans, programmes but hardly translated as package for micro level implementation. Also NGOs activities are donor driven and are sectoral and more to address some component of the ecosystem. In this study we have tried to review the activities of GVNML and seen them in climate variability/change context.

GVNML interventions were not in the context of climate change adaptation and mitigation but definitely aiming at sustainable livelihood by restoration of the productivity of village natural resources, i.e., land, water, and vegetation and enhance ecosystem services. The interventions were not limited to just planting trees but the emphasis was on restoration of ecosystems and habitat diversity particularly of pastures. Innovating Chauka system for pasture lands, field

bunding and ponds on farm lands, and shift in perception of people from exploitation of natural resources to conservation of resources by organising community march the GVNML have been the main interventions to strengthen the resilience of people. The major outcomes of their interventions were as follows:

Outcome of interventions:

1. Increase in soil moisture conservation and soil health.
2. Regeneration of grasses, bushes, trees and medicinal plants.
3. Increase in availability of fodder and fuel wood.
4. Reversion of degraded grazing and barren lands to productive/sustainable grazing lands
5. Improvement in the productivity of agricultural lands.
6. Natural farming being adopted by farmers and the number is increasing.
7. Rejuvenation of traditional water harnessing structures with community participation ensuring drinking water security.
8. Fodder and water security to animals.
9. Food security through field bunding and farm pond on agricultural lands and fuel security by regeneration of pasture and grazing lands.
10. Increase in groundwater recharge by revival and conservation of traditional water harvesting systems/structures.
11. Revival of traditional community based institutions for management of village natural resources ensuring equity in access by all section of the village community. Establishment of local governance institutions.
12. Restoration of native biodiversity species conservation through development of Eco Parks.
13. Large scale afforestation and plantation of trees on different types/ownership of lands with peoples' active participation.
14. Shift in perception of people from exploitation of natural resources to conservation of resources.
15. Successful mass movement in around 150 villages by organisation of community march from one to other village to create awareness about protecting our environment and seek peoples' participation by committing to do some environment conservation activity, i.e., planting trees in house premises, in common lands, schools, near the water bodies, etc. and also take responsibility to protect them.

16. Strengthening of historically evolved mixed farming systems to cope with and adapt to the emerging climatic risks.
17. New capacity of people to take the challenges of climate variability/change.

Finally the GVNML has set an example that how at village level people can be equipped / prepared to take up the challenges of climate change by developing their own mitigation and adaptation strategies through enhancement of ecosystem services like hydrological services and biodiversity along with provisioning services like fuel, fodder, etc. and attain sustainable livelihood.

The massage for the policy makers is that to ensure the success of both climate change and development programmes, adaptation measures must be mainstreamed into existing development strategies, across all levels and sectors.