

Land Use Pattern and Ecology in the Madi Valley

Vinod P. Shrestha
Palpa Campus
Tribhuvan University

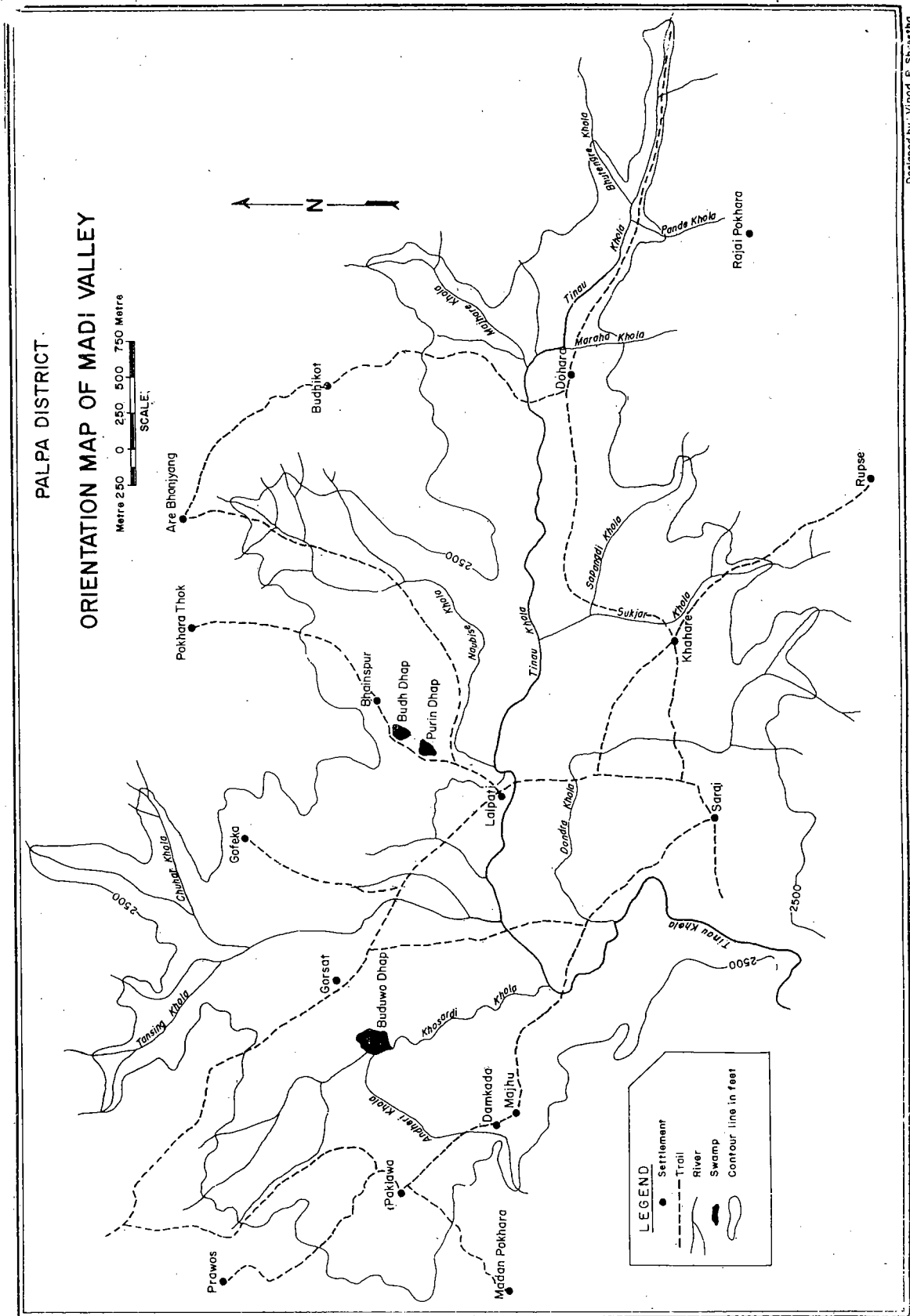
Background

This paper was prepared to analyse land use pattern in the Madi valley from the ecological viewpoint. Though the Madi valley is the biggest agricultural land in the Tinau watershed area, due to ecological and environmental problems, the land use pattern has been adversely affected, which has led to low agricultural production and frequent crop failure. Due to rapid population growth, there has been a marked increase in deforestation, soil erosion, landslides and flood hazards in recent years. The process of environmental deterioration and ecological degradation has resulted in loss of top soil and landslides along the surrounding hill slopes on the one hand and loss of agricultural land, fertility of soil and siltation problems in the fertile valley on the other. These critical problems have led to investigate and analyse the various causes that are responsible for adverse effect on land use pattern in the Madi valley which lies within the Tinanu watershed area of Palpa district.

The present study is an attempt to analyse the present land use pattern and effects of ecological degradation on land utilization in the Madi valley.

Methodology

The base map for land use in the Madi valley was prepared with the help of aerial photographs of 1972 on the scale 1:20,000. The map was up-dated at the time of field study in March 1981. The information regarding the present situation and problems of land use was gathered from the local farmers through questionnaires and interviews. The personal visual survey was done at the time of field study. Different types of land use categories were delimited with the help of one inch to one mile (1:63360) toposheet of 1959, aerial photographs of 1972 (1:20,000) and land use map (1:25000) of Tinau watershed area prepared by the Tinau Watershed Project. The study includes areas up to the altitude of 762 m. (2500 ft.) above sea level. The field study was conducted in the month of March 1981 in Damkada, Andhari Khola, Agani, Sukjor, Dohara, Pande Khola, Pipli and Gorsot villages which represent the whole Madi valley and all the panchayats that lie within (see Map 1).



Map 1

G
t
P
b
N
s
t
2
1
T
a
8
v
M
v
P
f
t
l
w
D
a
t
K
t
f
o
I
T
I
C
C
W
E
N
C
t
i
e
I
S

Geographic Reality

The Tinau watershed area which covers about 520 sq. km. lies within the hilly region of the western development region of Nepal is a part of Palpa district in the Lumbini zone. There are several small and narrow basins and valleys within the watershed area some of which are Redi, Madi, Nayapati, Hangadi, Dovan and Cachal. The Madi valley is an enclosed one surrounded by the Bahabharat Lekh which forms the biggest single agricultural land within the Tinau watershed area (Tinau Watershed Project 1980: 215). The average altitude of the Madi valley is about 7000 m. above sea level (Shrestha 2035 B.S.) and lies within the mid-land region of Nepal. The area of the valley is approximately 19.2 sq.km. (Shrestha 1982:17) and is about 3.69 percent of the total land area of the Tinau watershed.

The spatial location of the Madi valley lies between 83° 33' E. to 83° 39' East and 27° 48' N. to 27° 51' North. Geologically, the Madi valley is a tectonic valley (Sharma 1977:4). It is believed that the Madi valley of Palpa district is probably of lacustrine origin and provides extensive patches of flat land (Malla 1969). In the geological past, due to some movements in the earth's crust, the river flowing from the valley was obstructed and turned into a lake, which later in the recent geologic past drained away leaving the fertile valley. The low lying Madi valley has at present few water logged ponds and swamps which seem to be the remnants of a past lake, notable of which are Purin Dhap, Kalpu Dhap, Budh Dhap and Buruwa Dhap¹.

The drainage pattern in the valley is controlled by the landscape and slope of the land. The main river flowing from the Madi valley is the Tinau river. The other streams and torrents like Sukjor, Andheri, Khoserdi, Tansing, Chilangdi, Naubise, Bhutungre, Pande and Nakate are the notable ones and its tributaries. These river and streams originate from the surrounding hills of the Mahabharat Lekh. The general slope of the land is towards the centre and to the west-mouth of the valley. These streams flowing from the enclosed hills meet the Tinau river in the centre and flow together towards the west and then to the central Tarai through Butwal-Khasauli.

Because of low altitude and enclosed nature of the valley, the climatic conditions are similar to that of the Inner Tarai (Duns). The climatic conditions in the valley can be divided into hot and dry, warm and rainy, and cold and dry seasons. According to the climatological data collected from Lalpati centre (Madi valley) in 1980, the maximum temperature for the hot and dry seasons was 36.7°C and in the cold winter the minimum temperature was 4.2°C. The Madi valley lies to the north in the rain shadow of Kaude Lekh (1843 m). The annual rainfall for the year 1980 was 1827 mm (Tinau Watershed Project 1980) and the winter months are foggy.

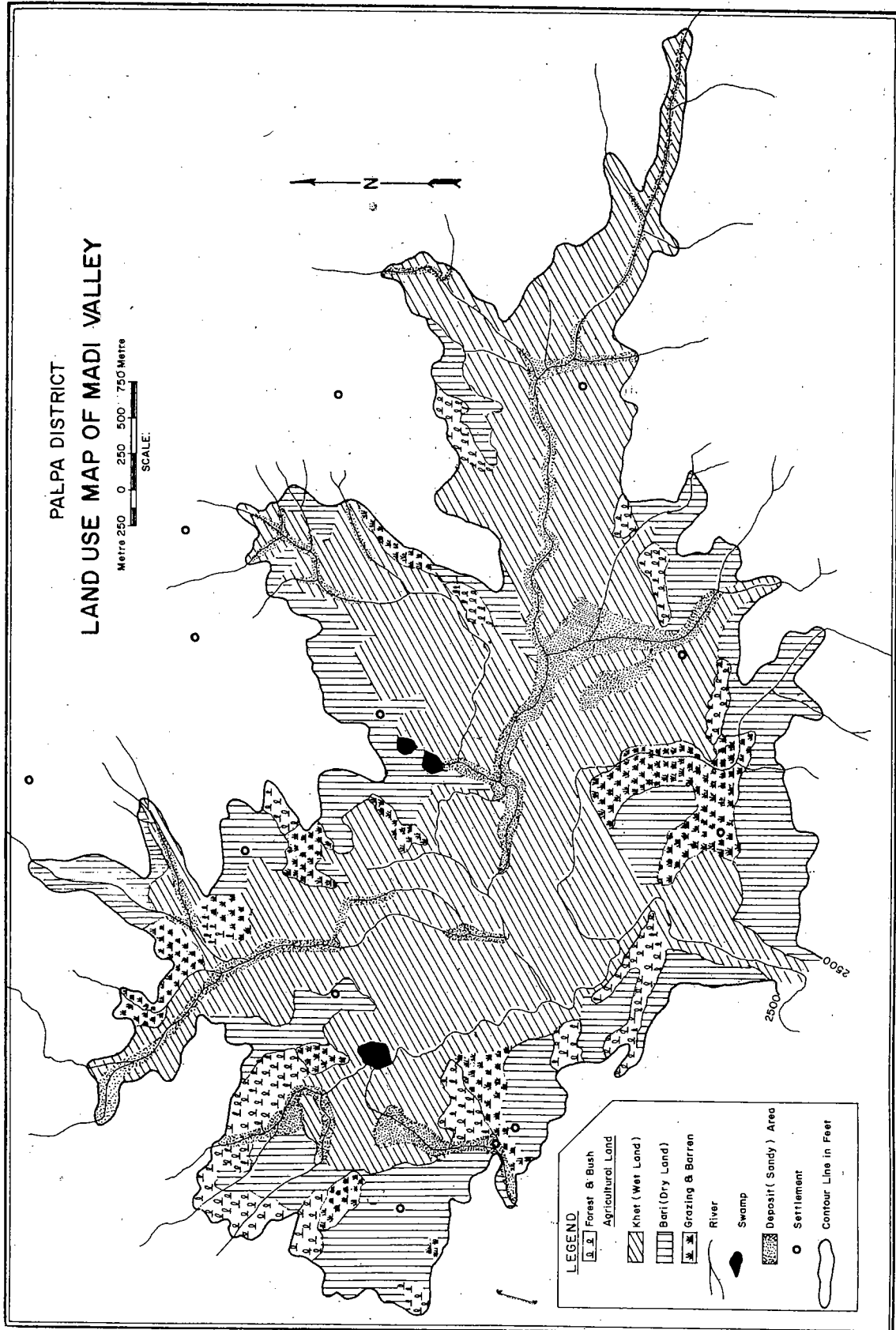
The soils at various locations in the Madi valley indicate that majority of them are in medium to high textural groups. The main soils found in the valley are sandy loam to silt loam. Apart from

these soils, eroded debris from the surrounding hills like sand, boulders, gravels and pebbles are found along the foot of the hills and in the bed and banks of the streams. The soils of the valley contain low to medium organic matter and possess mostly acidic soil reaction. Except in the western sector of the valley, nitrogen content in the soil is low. The soil in the western portion of the valley possesses mostly medium to high level phosphorus and rest of the areas show mostly a low level phosphorus content (New Era 1982:7).

Land Use Pattern

Land in Nepal is a basic and important natural resource on which more than 90 percent of the total population depends for living. According to the preliminary census report of 1981, the rate of population growth between 1971-1981 was 2.6 percent per annum (Gurung 1981) which is very high. Because of fast rate of population growth, the land-man ratio is decreasing rapidly. Consequently, there is an acute shortage of agricultural land in Nepal specially in the hills where agricultural density is three times more than that of the Tarai region (National Planning Commission 1974). In the Tinau watershed area, where about 1.38 hectares per head of land of all sorts have to meet the varied needs of the people. The per capita cultivated land for the whole watershed is only 0.23 hectares in average. Like in the other hilly region of Nepal land for agricultural use in the Tinau watershed is extremely limited because land resource is in short supply. In such a case planned allocation alone can assure optimum use of available land, because limited supply of land resource cannot meet the requirement of the increasing population.

The Midlands of Nepal which was originally woodland now have only a 10 to 15 percent forest cover (Kollmannsperger 1978-79). Though the Madi valley lies within the Midlands, has only about 4.8 percent of forest cover to the total land area. Due to lack of authentic data, it is difficult to say in what proportion the agricultural land is increasing at the expense of forest land. Due to rapid population growth (about 2 percent per annum in the area) the land use pattern in the Madi valley has become more complex. The change in land use pattern is most remarkable in the area between agricultural land and forest and pasture. The extension of crop land in the marginal land creates a chain reaction of contraction of pasture land and the overgrazing of woodland for crop land for dry crops and subsequent conversion of unirrigated land into irrigated land (Gurung 1969-70). Environmental deterioration is taking place along the slope of the enclosed hills of the Madi valley which has ultimately led to adverse effects on present land use pattern in the downstream area. Table 1 presents a general picture of land use pattern in the Madi valley (see Map 2).



Map 2

Drawn by: Iswar N. Manandhar

uld-
in
low
cept
s low
um to
phos

ch
cord-
n
ich
man
age
ural

it
l

y
s
ch a
land,
of

only
the
E
a,
in-
rowth
e Madi
most
sture
action
crop
nto
aking
ch has
he
attern

Table 1: Land Use Pattern in the Madi Valley

Land Category	Area in Hectare	Percentage of the total
1. Cultivated land	1510	78.64
2. Forest and Bush	92	4.79
3. Pasture and Meadow	120	6.25
4. Swamp and Water Bodies	28	1.46
5. Built-up Areas	30	1.56
6. Others (Barren and Debris)	140	7.30
	1920	100.00

Source: (Shrestha 1982:64).

Major Land Uses

Table 1 shows the total land areas under different uses: cultivated land, forest and bush, pasture and meadow, water bodies and built-up areas. Only about 7.3 percent of the total area is not usable for productive purposes. The land under this category includes barren lands, landslides, eroded areas and debris. The present situation of the different categories of land uses is as follows:

Cultivated Land: Cultivated land appears to be the most important and productive land use in terms of the coverage of the area. The cultivated land area of the Madi valley is 1510 hectares which amount to 78.64 percent of the total land area. Due to fertile soil, most of the land in the Madi valley has been converted into agricultural land. From the centre of the valley the percentage of cultivated land decreases progressively towards the foot and lower slopes of the enclosed hills. The Madi valley which is most ideal in the Tinau watershed area for rice production is not cultivated the year round. The cultivated land in the valley can be divided into two categories - (a) Khet² and (b) Bari³. The cropping intensity is estimated to be around 120 percent (Tinau Watershed Project 1980:40). To a certain extent, factors like soil depth, high water table, frequent change in the course of Tinau and Sukjor rivers and lack of irrigation facilities affect the cropping potential in the Madi valley. The major cereals grown in the valley are paddy, maize, millet, wheat, lentils, linseeds and some vegetable crops (in negligible areas). Most of the Khet lands (about 72 percent) are left fallow after the paddy harvest. Other major crops that are relayed/intercropped with rice are peas, soyabeans and blackgrams. Soyabean and blackgram are mostly grown on the bunds of the paddy fields (New Era 1982:7). The major cropping pattern followed in the Khet land in the Madi valley is shown in Table 2.

Table 2: Major Cropping Pattern in the Khet (Wet) Land in the Madi Valley

Cropping Pattern	Percentage
1. Rice-fallow	71.99
2. Rice-wheat	26.05
3. Rice-corn	0.37
4. Rice-rice (early paddy)	1.29
5. Rice-linseed	0.23
6. Rice-barley	0.04
7. Rice-lentil	0.03
Total	100.00

Source: (New Era 1982:7)

In the Bari land maize is the main crop in summer followed by millet, buckwheat, oil seeds and wheat. Mixed cropping and relay cropping with maize or planting other crops after the maize harvest is generally practised. These lands are located along the lower slopes and foot of the enclosed hills. The spatial extent of the coverage of Khet and Bari lands are shown in Table 3.

Table 3: Coverage of Khet and Bari Lands in the Madi Valley

Cultivated Land	Area in Hectare	Percentage to the Total Area
1. <u>Khet</u>	1098	57.18
2. <u>Bari</u>	412	21.46
Total	1510	78.64

Source: (Shrestha 1982:71)

Table 3 shows the higher percentage of cultivated land in the Madi valley where 78.64 percent of the total land is under cultivation. Khet land constitutes 73 percent to the total agricultural land where as Bari constitute only 27 percent. However, the major portion of the Khet land remains fallow because of the deteriorating ecological situation of the area. In winter, the rivers and streams in their upper courses become dry. The water in the river course disappears underground and reappears in the lower part of the valley creating springs in the paddy fields and the water remains logged even during the winter season upto mid March. These problems can be seen mainly in the South-Western part of the Amliyan area in the Madi valley. These water logged agricultural lands are left fallow in winter after the harvest of paddy crops due to excessive moisture. The problem of drying up of river beds in winter along the upper courses of the rivers on the one

hand and excessive moisture, water logged and swampiness in the lower courses on the other are responsible for the single cropping pattern in the valley.

Forest and Bush: The area covered by forest and bushes are only 92 hectares of land which is only 4.79 percent of the total land area of the Madi valley. Though the forest is most import land use from the viewpoint of ecological balance there is at present very limited area of forest left. These scanty patches of forest are mostly found along the foot of the mountain rim. Mostly in the forest area hard Sal (*shorea robusta*) and semi-hard deciduous trees are found mixed with bushes. In the valley proper, areas under forest are very small indeed because most of the forest land is encroached for cultivation. The forest produce, especially fuel and timber are in acute shortage in the valley.

Pasture and Meadow: Pasture and meadow land occupy 6.25 percent of the total area of the valley which amounts to 120 hectares of land. These lands are primarily public land left for common grazing purposes, which is normally covered with grass. Though pasture lands are distributed along the foot and lower slopes of the enclosed hills, broad pasture land is found in the Sarai Tar area. There is a very little area under fodder trees. Existing pasture and meadow are over grazed resulting denudation of soil and reduction of carrying capacity of pasture lands. Little or no attention is paid to cultivate fodders to support animal husbandry.

Swamps and Water Bodies: Swamps and water bodies cover an area of 28 hectares which is about 1.46 percent of the total land area of the Madi valley. Among the ponds and swamps Purin Dhap, Buduwa Dhap, Kalpu Dhap and Budh Dhap are notable and are believed to be the remnants of a big lake which had formed in the geological past. In recent years, the area under water bodies and swamps are increasing because of the deposition of rock debris and sand in the outlets by rivers and streams.

Built-up Areas: About 1.56 percent of the total land or 30 hectares of land in the Madi valley are covered by built-up areas. These areas include settlements, roads and trails. Most of the lands under this category are concentrated along the lower slopes and foot of the surrounded hills. Of the settlement areas Kunsare, Paklwa, Majha, Damkada, Simalghat, Sarai Tar, Khahare Khola, Lalpati, Gophek, Gorsot, Bhainspur, Sanseni, Rupse, Dohara and Pande Khola are notable.

Other Land Uses: Land use under this category includes barren and buried lands, land slip and eroded land which are unproductive. The areas occupied by this category is about 140 hectares which amounts to 7.3 percent of the total land area of the Madi valley. The once fertile agricultural land along the river course is now buried under rock debris, sand and pebbles leading to an increase in desert like unproductive land.

E
a
g
a
g
i
al
er
sa
cr
fc
ag
gr
th
Th
th
co
an
le
da
li
cr
su
ra
si
32
fr
va
kh
in
kh
ba
va
fo.
—
—
1.
2.
3.
4.

Effects of Soil Erosion and Landslides in Land Use Pattern

Though the Madi valley is the biggest and most important single agricultural land unit in the Tinau watershed area, environmental degradation along the slopes of the hills surrounding the valley have had a negative impact on land use pattern in the valley. Due to population growth of about 2 percent per annum, the basic demands for a livelihood in the area can under no circumstances be fulfilled from locally available land recourses. An ever increasing number of people who depend entirely on land for livelihood have to live for generations on the same small amount of land (Malla 1980). Further, lack of alternative job opportunities, the growing population is compelled to extend its cropland towards the marginal and ecologically sensitive areas which for reasons of structure, slopes and soil quality are not suitable for agriculture. Expansion of cropland on steep and unstable slopes, overgrazing of animals in the woodland and cutting down of the trees from the forest for fuel and timber are taking place everywhere in the area. The area under forest along the slope of the hills (especially along the slopes of Kaude Lekh and Lam Danda) is fast diminishing under the combined pressure of slash and burn cultivation, overgrazing of the animals and wood gathering for timber and fuel. Consequently this has led to soil and gulley erosion, landslides and flood hazards with much damage and disaster. The effects are permanent lowering of soil fertility, frequent crop failure, change in the hydrological cycle by increasing silt load along the river beds in the Madi valley.

The incident of flood hazards by swollen rivers flowing from the surrounding hill slopes is increasing every year. If the volume of rain water flowing down is doubled during heavy rainfall, then the erosive capacity will be increased 4 times and the transportation capacity 32 times (Killmannsperger 1978-79). The rivers and torrents flowing from the surrounded hills wash away debris and deposit in the fertile valley along the river beds. Every year in the rainy season fertile khet land is buried by sand pebbles and debris converting fertile land into waste land. The rivers which once flowed below the level of the khet land now flow above the level of khet land between vulnerable banks (New Erā 1982:11). At present rivers and streams of the Madi valley have damaged and deposited debris along their course in the following areas and localities:

Rivers/Streams	Localities
1. Sukjor (Khahare)	Southern part of the valley in Khahare, Beltari and Lalpati area.
2. Maraha	Dohara area.
3. Pande	Pande Khola area.
4. Tinau	Along the bed and banks in eastern portion of the valley from Bagchaur to Pande Khola areas.

- | | | |
|----|----------------------|---|
| 5. | Majhare and Naubise | North eastern part and Naubise Phat area |
| 6. | Chuhar and Tansing | North western part of Gopek and Gorsot areas. |
| 7. | Khosardi and Andheri | Western portion of the valley in Damkada and Paklahwa area. |
| 8. | Nakate | South western part of Aagani Khat area. |

During heavy monsoons, the above mentioned rivers and streams bring a huge amount of silt and debris from the surrounding hills and deposit it in the fertile agricultural lands and irrigation channels. The Chekuwa Kulo (irrigation channel) in the eastern part of the valley has been damaged by floods and debris deposition. At present the deposit area along the banks of the rivers are scattered through the valley. If the present deposition process continues in the future, the area of debris deposition will gradually expand, and further continuation of the process will lead to join the deposit area converting the whole valley into one big desert land. The heavy rainfall (more than 200 mm of rain within 14 hours) of Aswin 13, 2038 B.S. (late September, 1981) in the valley seriously damaged the standing crops and serious deposition problems caused by Sukjor Khola (Khahara), Tinau, Maraha and Andheri Khola. Sukjor Khola completely washed away Beltari Khet while the Tinau Khola washed away more than 150 ropani of agricultural land near Dohara (New Era 1982:11). Similarly Andheri, Tansing and Nakate Khola also made serious damage and buried agricultural land under debris. The heavy deposition of debris by the rivers along its beds have resulted in raising the level of the rivers even during normal rains. These rivers often change their course converting fertile land by depositing debris into unproductive waste lands on the one hand and damages the standing crops on the other. According to one inch to one mile (1:63360) toposheet of 1959, the total area under deposition was only 9 hectares but the area has increased to about 140 hectares in 1981. Thus within a short period about 22 years, the area under waste land has increased by 16 times (Shrestha 1982:69). This process of siltation in the Madi valley has had adverse effects on agricultural land use. Because good and fertile agricultural land of the valley is being converted into unproductive deserted land every year. Because of ecological constraints (soil erosion, landslides and flood hazards) productive capacity of the fertile valley has not yet been able to be fully utilized. Due to spreading aridity and lack of proper water management there has been a tendency to grow dry crops like wheat, maize, and mustard in the khet lands of Andheri Khola and Sukjor Khola areas where previously paddy was grown. Because of increasing problems of soil erosion, landslides and flood hazards, double or triple cropping agricultural lands are gradually being converted into single cropping agricultural land. Thus, soil and gully erosion and landslides along the slopes of the enclosed mountain rim of the Madi valley have resulted in converting the valley into a semi-desert-land, thus having a negative impact on proper land use pattern.

Conclusion

Though the Madi valley is the biggest agricultural land in the Tinau watershed area, which is ideal for paddy production is not cultivated all the year round. Because of ecological and socio-economic constraints in the valley, cropping intensity is estimated to be only 120 percent. For proper land utilization in the valley, ecological constraints like flood hazards, debris deposition, water logging in the agricultural fields and frequent changes in the course of river should be checked by different preventive as well as protective measures like correction of river beds, plantation of trees along the river banks, construction of check dams and embankments and diversion of water from water logged paddy fields through proper water conservation and management. Droughts and flood hazards are the two main problems in proper agricultural land use in the Madi valley, while former needs provision of proper irrigation and conservation of water through scientific management where as latter requires proper drainage and flood control measures. Traditional cropping pattern followed in the Madi valley needs adjustment and change in view of the increased basic demands of the people, and at the same time appropriate land use measures based on conservation policies should be adopted to discourage the unwise and wasteful use of land and to preserve the valley from the grip of ecological disaster.

NOTES

1. Dhap means swamp or marsh.
2. Khet land is used to grow paddy, usually lowlands along the side of the rivers which are irrigated or wet land.
3. Bari is unirrigated dry land usually up lands where maize is grown as the main crop.

REFERENCES

- Gurung, Harka, 1981. "Population Change in Nepal (1971-1981)". The Himalayan Review, Vol. 13, pp. 1-22.
- _____, 1969-70. "Geomorphology of Pokhara Valley". The Himalayan Review, Vol. 2-3, pp. 29-49.
- Kollmannsperger, R., 1978-79. "Longe-Range Lansscape Change Under the Influence of Man." Journal of Nepal Research Centre, Vol. 2-3, pp. ?
- Malla, U.M., 1980. "Population and Development." Paper presented at the National Seminar on Population Education Through Cooperatives Organized by HMG/ILO/UNFPA.
- _____, 1969. "Physical Features of the Kingdom of Nepal and Prospects of Tourism." Nepal Industrial Digest, Vol. 4, No. 1, pp. ?

100 CNAS Journal, Vol. 11, No. 1 (December 1983)

National Planning Commission, 1974. "Draft Proposal on Task Force on Land Use and Erosion Control." Kathmandu: HMG/NPC.

New Era, 1982. "Constraints Analysis of Winter Crop Production in the Madi Valley, Palpa District." Kathmandu/Tansen: Tinau Watershed Project. (Mimeo.)

Sharma, C.K., 1977. Geology of Nepal. Kathmandu: Educational Enterprises (P.) Ltd.

Shrestha, Vinod P., 2035 B.S. "The Madi Valley of Palpa District: Necessity of Land and Water Conservation." Tansen Digest, Vol. 1, pp. ? (In Nepali).

1982. "In Context to Soil Erosion and Land use, the Madi Valley of Palpa: A Geographical Study." Unpublished Report. IOHASS, Tribhuvan University. (In Nepali).

Tinau Watershed Project, 1980. Tinau Watershed Management Plan: Volume I, Kathmandu/Tansen: Tinau Watershed Project.

