CHAPTER V

LAND SUITABILITY
CLASSIFICATION OF
THE UPPER Gundar Basin

Silk cotton plantation sandwiched between the Nallattevanpatti hills and red gram.
CHAPTER V

LAND SUITABILITY CLASSIFICATION
OF THE UPPER GUNDAR BASIN

INTRODUCTION

The present chapter deals with Land Suitability Classification of the Upper Gundar Basin. The suitability classes are delineated for eleven important crops and the suitable crops (not suitability class) are suggested for wasteland development in order to achieve sustainability of the basin. Having acquired good background knowledge on land evaluation techniques based on the FAO, the resource base of the basin in Chapter II, the existing spatial pattern of land uses based on satellite images and human interaction with land and the land utilisation types through questionnaire survey to understand the managerial factors have been brought to light in Chapter III. Further, in Chapter IV, the land characteristics have been analysed to assess the strengths and weaknesses of the 15 land systems and numerous land units of the Upper Gundar Basin. Based on the above and the results of these analyses, each land unit of different land systems under various mini-watersheds have been assessed to bring out the land suitability classes for eleven crops and also for wastelands, in this chapter.

The land characteristics of each land unit have been studied along with the limitations in the land evaluation table for the matching of the present status of land (quality) with the requirements for eleven crops and some wastelands. The land evaluation table for each mini-watershed consists of information on land systems, land units and area, soil series, existing land uses, land characteristics, suitability classes for eleven crops and wastelands and remarks (Appendix 5.1).
The land evaluation table is very much useful in carrying out developmental activities at each mini-watershed, while carrying out micro-level planning. This table gives the profile of each system that occurs in the mini-watershed and its land units. Based on the suitability of each class to depict their spatial distribution, the maps are drawn.

The purpose of land suitability classification is to explicitly display the crop-specific land suitability classification and the classes of suitability over which the crops may be grown with benefit. A general pattern of highly suitable land for some of the crops considered for analysis here is also discussed. The latter is considered as the optimal utilisation of land for cropping. The crops for which the land suitability classes are identified are: paddy, sugarcane, cotton, gingelly, sunflower, groundnut, pulses, millets, banana, coconut, chillies, vegetables, and fruit trees such as mangoes, guavas and sapodillas (sapota, in vernacular). Only a few crops find all classes of lands (highly suitable, moderately suitable, and marginally suitable: S1, S2 and S3 respectively) suitable for their cultivation while others find one or two of them actually available for cultivation.

For land currently not suitable (N1), however, options of cropping available are shown in separate maps. The options so discussed, for what is otherwise treated as wastelands, are agro-forestry (neem, pungam, tamarind and silk cotton), economic plantations (cashew, casuarina, teak and eucalyptus), energy plantations (prosopis, acacia and other fuel wood), and horticulture (custard apple, wood apple and jack). This chapter is rounded off with suggestions for further development with regard to land suitability analysis.
LAND SUITABILITY CLASSIFICATION

The process of land suitability classification is the appraisal and grouping of specific areas. There are, in general, four categories or levels of classification: Land Suitability Orders, Classes, Subclasses and Units. The present study has not used the units, whereas the land units are the basis for classification by grouping of specific areas. However, the limitations (sub classes) in the context of the study area are dealt with in the text. The suitability classes are assessed separately for each kind of land use under consideration, with respect to each land mapping unit in the surveyed area. Qualitative evaluation and the assessment of current or potential land suitability are applied to the same classes.

The definitions adopted in the study are as follows:

DEFINITIONS OF SUITABILITY ORDERS, CLASSES AND SUBCLASSES

SUITABILITY ORDERS

The land assumed as suitable (S) for some specific use, may not be suitable (N) for the use under consideration. The three main reasons why land may be classed as not suitable are: the proposed use is technically impractical, as in cultivating on very thin or loamy soils is environmentally undesirable; that is, cultivation would lead to severe soil erosion; or is economically unprofitable, the income from estimated prediction being less than the cost of the required inputs.

S (Suitable). Land on which sustained use of the kind under consideration is expected to yield benefits justifying inputs, without unacceptable risk of damage to land resources.
N (Not Suitable). Land which has qualities that preclude sustained use of the kind under consideration.

Suitability of land is classified as under in Table 5.1.

### Table 5.1: Structure of Land Suitability Classification

<table>
<thead>
<tr>
<th>Order</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suitable (S)</td>
<td>Highly Suitable (S1)</td>
</tr>
<tr>
<td></td>
<td>Moderately Suitable (S2)</td>
</tr>
<tr>
<td></td>
<td>Marginally Suitable (S3)</td>
</tr>
<tr>
<td>Not Suitable (N)</td>
<td>Currently Not Suitable (N1)</td>
</tr>
<tr>
<td></td>
<td>Permanently Not Suitable (N2)</td>
</tr>
</tbody>
</table>

**SUITABILITY CLASSES**

These indicate the degree of suitability. Within the order suitable, the three classes, highly, moderately, and marginally suitable, are defined in relative terms. The S1/S2 boundary, or lower limit of highly suitable land, should be set at the point where conditions have become clearly less than optimal. Crop yield or other forms of production are slightly but definitely lowered, or inputs to counter the effects of a limitation become needed. Highly suitable land is not the ‘perfect’ land for the use in question, but could be described as the best that might reasonably give hope. The S2/S3 boundary dividing the moderately from the marginally suitable land should separate land which, whilst it has some limitations, is quite clearly suited to the use but only by a small technical, economic or environmental safety margin. Note, however, that marginally suitable land lies wholly within the order suitable and is not intended to straddle the border with not suitable land. What follows is a brief description of the classes of land suitability.
**Highly Suitable (S1).** Land having no significant limitation to sustained application of a given use or only minor limitations that will not significantly reduce productivity or benefits and will not raise inputs above an appreciable level.

**Moderately Suitable (S2).** Land having limitations that in aggregate are moderately severe for sustained application of the given use. The limitations will reduce productivity or benefits and increase required inputs to the extent that the overall advantage to be gained from the use, although still attractive, will be appreciably inferior to that expected on class S1 land.

**Marginally Suitable (S3).** Land having limitations that in aggregate are severe for sustained application of a given use and will so reduce productivity or benefits or increase required inputs that this expenditure will be only marginally justified.

**Currently Not Suitable (N1).** Land having limitations that may be surmountable in time but which cannot be corrected with existing knowledge at currently acceptable cost; that is, the limitations are so severe as to preclude successful and sustained use of the land in the given manner.

**Permanently Not Suitable (N2).** Land having limitations that appear so severe as to preclude any possibilities of successful, sustained use of the land in the given manner.

Of the two classes within the order *not suitable* (N), N1, indicating *currently not suitable*, refers to land on which the use under consideration is technically possible but not economic; at present prices, the cost of inputs need to
overcome the limitations would exceed the cost of production. Changes in the relative prices of the products and inputs, or advances in technology, for example, new drought-resistant crop varieties can result in upgrading the currently not suitable (N1) land. N2, indicating permanently not suitable, is applied to land on which it is unlikely that any foreseeable change in technical or economic conditions would render it viable for use. The N2 subclass is widely applied to steep slopes, swamps, rock outcrops and arid land. The boundary between S3 and N1 is defined in economic terms and is variable with time, according to changes in relative costs and prices. That between N1 and N2 is a physical boundary, which is relatively permanent.

LAND SUITABILITY FOR CROPS

All lands, from highly suitable to marginally suitable and even the land currently not suitable, support a range of crops, both primary and secondary growths (vegetation). Given this fact, it is possible to identify the suitability of these lands, or land units, therein, particularly for certain crops. For cropping, it is intrinsically assumed that the land currently not suitable and land permanently not suitable are not considered under cropping. However, treating land currently not suitable as wasteland, suitability of the wasteland for other economic options has been considered and described. It is also understood that the land currently not suitable could be put to use, after some improvement to cultivate some crops profitably. The details of land suitability in all aspects for different crops are shown in Appendix 5.1. Appendix 5.2 provides information on the area of crops under various land suitability classes under each mini-watershed. It must be pointed out here that, as all areas are suitable in some way or the other to several crops, they are counted or measured over and over again and hence the percentages do appear huge in the aggregate.
LAND SUITABILITY FOR PADDY

Paddy, a staple crop, is a versatile food crop, which can be grown in an area having rainfall between 550 – 750 mm, plain lands with soils of clay, silty clay, sandy clay, clay loam or silty clay loam for a depth of more than 75 cm and poorly drained soils. With pH between 5.5 and 6.5, gravel surface less than 3 per cent and sub surface less than 15 per cent, CEC > 20 and CaCo3. 0 - 5 per cent. Strictly speaking, these physical conditions ensure that paddy be grown with maximum yield under the suitability class of S1. However, Indian farmers are concerned more about the rainfall, soil type, slopping and topography (degree of hardness to use implements) and the pH in a given area and the physical conditions met. It is strange that the study has not found highly suitable land (S1) for paddy cultivation (Figure 5.1), for such land is put to use for other more important and commercial crops.

Farmers of the basin grow paddy necessarily as a food crop, either for subsistence or for sale on excess. So, marginal farmers to large farmers cultivate paddy, primarily to meet the household requirements. As it is not a commercial option and fetching good income, the farmers are reluctant to grow more than their subsistence levels. However, farmers own such lands where nothing but paddy can be grown during the seasons. As such some of them may be left with a surplus, which they sell and such sales do not bring big money to the cultivator. Farmers of the Upper Gundar Basin are expert paddy cultivators as they have been cultivating this crop for a very long time. After the introduction of the green revolution in the early 1960s, farmers all over the basin turned to modern methods of paddy cultivation and have taken to practices in tune with the changing times.
High yielding varieties and adoption of fertilizer and pesticide application have become widespread. However, in the last few years, there has been a relenting on the part of the advocates of modern techniques of cultivation and the farmers themselves. Organic and green cultivation is on the increase. The agro-industrial scene is getting better. There are several rice mills dotting the area and most of them have a town-base.

The managerial capability of the farmers is never in question, but the land suitability is. It is a surprise to see that the crops grown from very long historical periods do not give good yield at all. But the yield of paddy from Tamil Nadu is one of the best in the world. The constraints are therefore of land with constraints and irrigation (moisture availability).

**Moderately Suitable Land (S2).** The lands under pediplain, shallow buried pediplain and deeply buried pediplain systems in the head reaches of the basin, located in the vicinity of hills and good groundwater potential are the major positive factors for growing paddy. The soil series presented in these areas are the Doddappanayakkanur, Usilampatti and Udayanendal and are the series from the same family, but slightly different in their characteristics.

The requirements for paddy reveal soils mostly with silt and clay. This soil series fulfills the requirement as depth up to 150 cm, moisture in terms of irrigation and rainfall and the pH value being conducive to keep the land under S2. However, low silt content and well-drained (requirement poor drained), surface coarse texture, low CEC and low water holding capacity reduces its suitability for S1 to S2 classes. Hence, the application of organic matter, tank silts (tanks are more under S2 class area) may be added to increase fertility and water holding capacity. A few of the pockets of S2 class in the other part of the
basin are meagre. It should be noted that the water classes vary from C2S1 and C3S1. Hence, care is to be taken in the selection of salt tolerant varieties. Organic manure like daincha, sespania and calotropis may be added as green manure during the preparation of land for paddy cultivation. This class of land under paddy covers an area of 5,950 ha or 6.9 per cent of the total area of the basin.

**Marginally Suitable Land (S3).** The land systems like the shallow and medium buried pediplain, shallow and medium buried pediments and valley fills are found to have land marginally suitable where the soil series are the Koppuchittampatti, Karisalkulam, Savesapuram, Udayanendal, Ramanujapuram, Kottagapungulam, Vadipatti and Peraiyur. All these soils are suitable for paddy as good as the soils stated in class S1 but their soils have few constraints like:

- The Vadipatti, Peraiyur, and Udayanendal have surface coarse texture, low cation exchange capacity and water holding capacity, low organic matter and low fertility.
- The Savesapuram soil series has constraints for paddy cultivation and has shallow depth (50 cm), gravel, hardness, well-drained conditions and low fertility status.
- The Ramanujapuram soil series have alkalinity hazard.
- The Karisalkulam soil series have strong calcareousness.
- The Kottagapungulam soil series have severe solidity that brings it to class S3 of the type marginally suitable.
Further, all these areas are located along the main path of the river. Though water is available, the alkalinity increases from the middle part of the basin and reaches the lower part. It is evident that the soil series from the upper basin to the tail end are arranged and the pH value is assessed, which increases towards the middle and the upper parts. Further, the land is plain and has high alkaline levels. These are the major reasons that have kept these areas under class S3. In figure 5.1, the above description has made clear the distribution of lands marginally suitable for paddy in such a way that it is too widely scattered, but mainly in the middle and the tail end along major tributaries and rivers. This class covers an area about 8,700 ha or 10.1 per cent of the total area of the basin.

LAND SUITABILITY FOR SUGARCANE

Sugarcane is a commercial crop that farmers have taken to, quickly in the 1970s when modern inputs became available and there was an increase in the commercialisation of agriculture. The agricultural scenario changed with a number of agro-industries, most importantly sugar mills established in and around the study area. Madurai and Virudunagar have sugar mills to which the cane from here is being sent. Farmers find themselves assisted and helped by the sugar mills in their cultivation, with extension and credit when needed. The mill administration provides for extension needs, credits and all other assistance in exchange for the product. Cane is procured at the government-fixed, fair prices and hence no one is the loser, although farmers do feel that the price is still not what they have been earning for their products but the pricing is not in their hands. It is either with the government or with the private merchants.

It is an irrigated and an annual crop, requiring good water for almost three seasons in any agricultural year. When farmers found surface water scarcity, but
at the same time possibilities for using underground water looking bright both by
the known underground water potential and technology for extracting the
underground water (borewells and pumpsets), they quickly and increasingly took
to the cultivation of sugarcane.

Their traditional wisdom, coupled with the newly found information from
extension, private or public, helped the spread of sugarcane throughout the 1970s
and the process of ‘filling-in’ in the 1980s. It is grown almost everywhere, but
preferably on lands suitable also for paddy. As can be seen from figure 5.2,
sugarcane can be grown on lands highly suitable (S1), moderately suitable (S2)
and marginally suitable (S3). Lands highly suitable are found mostly in the head
reaches of the Upper Gundar basin, amidst the areas moderately suitable for
paddy; but not as extensive as that of land under paddy. Sugarcane can also be
grown in lands moderately suitable and as such as an alternative for paddy where
surface water is scarce and underground water potential is high enough. There
are smaller pockets of land moderately suitable downstream but very restricted in
area. Middle and tail end reaches of the Upper Gundar basin have large tracts of
lands marginally suitable and could be used for sugarcane. Interspersed are the
lands not currently suitable (N1) and lands permanently not suitable (N2). Such
lands are concentrated mostly in the middle and tail end reaches.

**Highly Suitable Land (S1).** In the Upper Gundar basin, the lands
confined to the pediplain, shallow and deep buried pediplain, systems are highly
suitable for growing sugarcane. The requirements are clayey loam, silty clayey
loam, and sandy clay with poorly drained to moderately well-drained soils. The
soil depth must be more than 100 cm, surface gravel less than 15 per cent,
caution exchange capacity less than 20 and pH 6.0 to 7.5 should be met.
Irrigation must be provided once every 10 or 12 days where the sandy loam soils
occur and once every 8 days for dry and porous areas. In deep clayey loamy soil, irrigation interval is 2 - 3 weeks.

In the study area, the Doddappanayakkanur soil series in the upper reaches of the basin is found to be highly suitable. It is very deep and go up to 1.7 metres. Good drainage and good irrigation keep the area suitable, especially, in the Thullakuttinayakanur, Vanderi, Mallapuram, Sulapuram, Uttapuram, Eramarpatti and Silanayakkampatti mini-watersheds. Further, the location of these areas influences sugarcane cultivation. Because of all these, lands are found along the down slope of pediments, which occur along the foothills. These areas have good depth of soil and are highly weathered zones, facilitating the occurrence of good groundwater potential.

Though the soils are slightly lighter, adequate irrigation increases its suitability. Since the natural soils are of low organic matter and low fertility status, adding silt enriches them and also the organic matter brought from the tanks and from the adjacent hill tracks. These hill tracks under charnockite facilitate high weathering with ferrous aluminium content along with the long withered leafy and vegetable litters that increase the fertility rate. These positive aspects keep the area of the pediplain, shallow and deep buried pediplain, with the Doddappanayakkanur soil series highly suitable (S1). The total area falling under this class is 1,710 ha or 2.0 per cent of the total area of the basin. Further, some areas with the Doddappanayakkanur soil series support banana, coconut and mango.

**Moderately Suitable Land (S2).** The land systems such as the pediplain, shallow buried pediment and deep buried pediplain, are moderately suitable for sugarcane. These systems are within the systems mentioned under the suitability
class S1. These lands are with the Udayanendal and Usilampatti soil series found nearer to the highly suitable lands. These soils are of the same family although with slight variations in their character. Since these areas lie near the tanks, they have good groundwater potential. The lands adjacent to the S1 class are with other soil groups like the Usilampatti and Udayanendal soil series. Both the soil series are from the family of the Doddappanayakanur soil series. The low organic matter and low fertility reduces its suitability for sugarcane from S1 to S2 class of moderately suitable lands.

Further, the location of these soils is confined to the areas of garnet biotite gneiss and calcareous gritty sandstone and clay and such areas have poor groundwater potential. In the study area, moderately suitable land for sugarcane is 4,640 ha or 5.4 per cent of the total area of the basin. It should be noted that, these soils, loamy sand or sandy loam to sandy clayey loam need the application of tank silts and organic matter by raising daincha and sespania crops in them to increase their fertility and water holding capacity.

Marginally Suitable Land (S3). The marginally suitable land, where sugarcane can be cultivated, is spread over several land systems in the study area. They are the pediplain, shallow and medium-buried pediments and shallow and medium buried pediplain systems confined to the lands adjacent to the river courses and nearer to the rainfed tanks. These features are encountered in the middle and lower reaches of the basin. Areas away from the river courses and tanks are not suitable as they have a low groundwater potential. This class covers an area of 9,840 ha (or 11.4 per cent) of the basin area. The soil series is one of the important factors determining the suitability class. The soils like the Palayampatti, Vadipatti, Peraiyur, Savesapuram, Ramanujapuram, Koppuchittampatti and Karisalkulam soils are associated with the lands along the
river courses under marginally suitable (S3) class and under the cultivation of sugarcane. The reasons for being marginally suitable are as follows:

- Shallow depth of less than 50 cm, general hardness of soil, low fertility of the Savesapuram and Palayampatti soil series.

- Alkalinity hazard, imperfect drainage, high free CaCO$_3$ of the Ramanujapuram and Koppuchittampatti soil series.

- Low CEC and water holding capacity, low organic matter, low fertility of the Vadipatti and Peraiyur soil series.

- The strong calcareousness of the Karisalkulam soil series.

These limitations reduce the suitability of these lands to the cultivation of sugarcane. Good drainage conditions are needed in the Ramanujapuram and Koppuchittampatti soil series. The Palayampatti soil series have conserved moisture during summer with trash mulching amidst the cane rows, which is much needed.

**LAND SUITABILITY FOR COTTON**

Cotton is a traditional commercial crop, grown in these areas for long, catering to local ginning and textile mills. Farmers are adept at the cultivation of cotton and have traditional knowledge of the methods as well modern practices. Cotton yields are good and the crop is generally much preferred among the farmers, although pests have become a problem in recent years. Protection practices and pest management still require the use of chemical pesticides, which
cause pollution levels to rise. The pricing of cotton has been a problem while marketing has not been.

The requirements for growing cotton are the use of 700 mm to 900 mm rainfall, the growing period 150-180 days and flat to gentle slopes (less than 3 per cent). They also include moderate erosion, moderate to well-drained condition, soil depth of more than 100 cm, soil types of silty clay, clay for the rainfed, sandy loam, sandy clayey loam and clayey soils. Such requirements make the land suitability class S1, which is highly suitable (Figure 5.3).

While assessing the land characteristics of each land unit, it has been observed that cotton could be cultivated in land units under systems such as the pediplain, shallow and medium buried pediments, shallow, medium and deep buried pediplains, pediments and uplands. However, the suitability classes vary according to the presence of soil series in these systems, moisture availability, slope, topography, location and association of the land units.

**Highly Suitable Land (S1).** Cotton is grown elsewhere because of farmers' preference for the highly suitable areas, which fall under the pediplain, shallow, medium buried pediments, shallow and medium and deep buried pediplains under this class. The study area has 17 soil series, of which the Doddappanayakkannur series (loamy sand to sandy clayey loam), Ramanujapuram series (clayey loam to clay) and Koppuchittampatti series (clayey loam to clay) are fit to grow cotton in their optimal level and fulfill the requirements of cotton. It is grown in extensive areas. The highly suitable area has been estimated at 16,900 ha or 19.7 per cent of the basin area. Cotton is grown both as a single and double crop during the agricultural year. The single crop dominates mainly due to the northeast monsoon and supplementary irrigation. However, the intensity of
irrigation is high in the upper reaches of the basin whereas in the middle and lower reaches it is low. Erosion is almost absent as the land systems are flat. Hence, moisture availability, erosion free, soil suitability and workability are conducive in these areas and are present in the highly suitable class.

The general limitations of the lands under cotton are that they are either heavily clayey in texture, with cracks developing during summer, which is typical of black cotton soil and imperfect drainage. The lands therefore require more summer ploughing and soil cover crops. It should be noted that the soils in the lower reaches of the basin are likely to develop alkalinity and there is a need to improve the drainage conditions, even while selection of crop varieties is important. In fact, the farmers of the area select one or two robust varieties of cotton that are hybrid and high yielding.

**Moderately Suitable Land (S2).** This class occupies an area of 17,040 ha or 19.7 per cent of the total area of the Upper Gundar basin. All the land systems are suitable under this class except for the hilly track and pediment areas that depend upon the soil series. This class of lands is distributed mainly along the streams and river courses and also the pediplain and deep buried pediplain in a variety of hills and pediments. The drainage is good as it follows the general slope of the basin. However, soil series of the Usilampatti (loamy sand to sandy clayey loam), Karisalkulam (sandy loam to sandy clayey loam) differ from the soils suitable for S1 class that were given earlier. These three soils, low in fine texture and slightly low caution exchange capacity of the Usilampatti series and Udayanendal, high calcareousness of the Karisalkulam, have brought areas under class S2 for cotton. Hence, the soil series is the limitation.
Cotton is grown both as a single and double crop. The double crops are predominant in the upper reaches of the basin, where the lands lie in the vicinity of hills and pediments. These areas have good groundwater potential and thus cotton is grown as a double crop in the given soil series. The single crops are also grown under rainfed conditions.

It should be noted that the lands suitable for cotton under S2 class have good, potential soils. As far as the groundwater potential is concerned, the upstream part of the basin has higher potential as it has good depth of soil, which has long been highly weathered. The unconsolidated, weathered materials facilitate holding more groundwater. In contrast, the downstream parts the basin are highly plain, where soils are mostly in situ and hornblende biotite gneiss subjected to low weathering and small thickness of the weathered material. Thus, the areas around are with low groundwater potential. Further, the lower reaches are likely to be sandy clayey loam. The organic matter and tank silt are applied to the upstream reaches of the basin and gypsum to the lower reaches of the basin to reduce alkalinity and increase the water holding capacity.

**Marginally Suitable Land (S3).** This class is distributed sporadically throughout the basin in all systems of various mini-watersheds except the hills and pediments. The upland plains are also suitable for S3, adjacent to class S1 or S2. The middle of the basin and the northern part of the Gundar excepting the lower reaches are not included in this category. These areas show as many as eight soil series, capable of supporting cotton but marginally suitable. The soils found in this class are the Palayampatti (loamy sand to sandy loam), Vadipatti (sandy loam to sandy clayey loam), Peraiyur (sandy loam to sandy clayey loam), Savesapuram (sandy loam to sandy clay), Kottagapungalam (sandy clayey loam to sandy clay), Taraganendal (sandy loam), Perumalpatti (loam sand to sandy...
clayey loam) and Tammasanapatti (sandy loam to sandy clay loam). These soils are, though not akin to the soils described for class S1, are suitable for cotton, due to the presence of clayey loam.

However, lands under this class lack moisture, are susceptible to erosion, and have low fertility, topography and imperfect drainage. Further, due to the lack of moisture, plugging is somewhat hard and they use implements. As water sources are absent, the lands reflect on the dryness. Hence, these limitations have brought the land under class S3. The little moisture and cracks during summer necessitate soil cover crops, which are most important, especially in marginally suitable lands. The application of organic matter and tank silt is absent due to the absence of tanks in these areas.

The area under the marginally suitable category is 7,030 or 8.1 per cent of the basin. This covers the Chandrakulam, Kulisalkulam Sundarangundu, Odaipatti, Kallugudi, Kunnathur, Ammapatti, Thummalpatti and Pappinayakkkanpatti mini-watersheds.

LAND SUITABILITY FOR GINGELLY AND SUNFLOWER

There are oilseeds such as gingelly and sunflower that are much preferred as commercial crops by the farmers to make some money to spend. Gingelly is a traditional crop, whereas sunflower has been introduced in recent times through commercialisation of agriculture. Farmers do know how to cultivate gingelly and sunflower and they have by now built local expertise in the cultivation of sunflower. Gingelly, more often than not, is grown as a mixed crop with other traditional such as the country beans (locally known as mochai) and red gram. As gingelly is a nutrient-extracting crop and depletes soils of their fertility, it is
grown with the traditionals to shore up the nutrients of the soil. *Mochai* and red
gram are crops that build nitrogen in the soil and in the nodules that can be
extracted. Also, the practice of mixed cropping is towards maximising
production and benefits and as such the crops are harvested at different times,
even if they are sown at the same time. *Gingelly* gets harvested first, followed by
*mochai* and red gram. While gingelly may be sold as a commercial crop, *mochai*,
which gets harvested over a few weeks or months, is for home consumption. So
is the case with red gram, which is, if sold at all, sold only in small quantities.

Sunflower on the other hand is a pure commercial and is sold after the
harvest is processed on-farm. It is also a profitable crop and is occasionally
grown as an inter-crop in young coconut gardens and silk cotton. This crop has
good market value and the farmers have become well versed in the last two
decades in the processing of the seeds, the basic raw materials for oil. Besides
oilseeds have always had ready markets. When compared to other crops, the
oilseeds are not very expensive to cultivate, although they would need care and
protection just as other crops. Figure 5.4 shows that gingelly and sunflower could
be grown almost everywhere in the basin and that moderately suitable lands
occupy most of the head, middle and tail end reaches and that marginally suitable
lands are in scattered pockets, again almost everywhere in the basin.

**Moderately Suitable Land (S2).** Sunflower and gingelly have almost the
same requirements. Sunflower was introduced in India in 1969 and at present 0.6
million ha of area is under sunflower. Sunflower is mainly grown for its oil. The
oil is used for chicanery purposes in the preparation of *Vanaspathy* and also in
the manufacture of soaps and cosmetics. It is especially recommended for heart
patients. It takes in protein and is used as a cattle and poultry feed. For the
optimal growth of sunflower, the suitability requirement is 700-1,000 mm. The
crop can thrive well in a variety of soils. It performs well, neutral and well-drained light soil as well as heavy soils. It performs better than groundnut in the heavy black cotton soils of Tamil Nadu State. Having a pH of 6 to 7.5 they grow well up to 8.5. It will grow but yield will decrease. Erosion may be medium, slope flat to gentle. The altitude is not a limited factor. Further, it is possible to cultivate sunflower throughout the year. It grows when rainfed as well as when irrigated. Irrigating the crop can double the yield. In general, for light soil 9 to 10 and for heavy soil 5 to 6 times of irrigation are sufficient. The sunflower crop matures in 90-100 days.

Sunflower and gingelly could be grown in the upland plains, pediments shallow and medium buried pediments, and the shallow, medium and deep buried pediplain. In the study area 9 soil series are found to be suitable. They are the Vadipatti, Peraiyur, Usilampatti, Doddapanayakkamur, Sundarangundu, Ramanujapuram, and Udayanendal soil series. They are grown as single or double crops. About 35,160 ha of the area of the basin or 40.7 per cent of the total area of the basin is moderately suitable. In the context of the study area, the soils are good, though it grows under a different variety of soils. The most important factor is that the crop requires a cool climate during germination and seedling growth, no warm weather from seedling stage up to flowering and on cloudy, sunny days during flowering to maturity. As far as the study area is concerned the climate is semi-arid and thus cool climate is absent. Because of these limitations, the highly suitable under class S1 is absent and hence there lands set in moderate suitability or the S2 class. In the study area, except for the hilly tracts, the bazada, pediment, eroded lands and other systems are generally suited for these crops. In general, in the double cropping areas of each mini-watersheds, sunflower is grown as irrigated crops. The parts of these areas are
under rainfed and single crop in a year, especially late in the rabi season (Figure 5.4).

**Marginally Suitable Land (S3).** Almost all the land systems involved in the case of marginally suitable lands are fit to be under this class but the areal extent of the marginally suitable (S3) is much restricted. It covers an area of 5,340 ha or 6.2 per cent of the total area of the basin. It should be noted that the soil series under this class are different from soils under this marginally suitable class. The soil series under marginally suitable class are the Palayampatti, Kottagapungulam, Taraganendal, Perumalpatti and Tammasanapatti. The land is mainly associated with single crop areas under rainfed conditions. The Taraganendal soil series is found under the Tadayampatti and Thummalpatti mini-watersheds, in the border of Madippanur and Appakarai mini-watersheds.

As stated in the previous section, the heavy texture of the black cotton soils in Tamil Nadu State is suitable for gingelly and sunflower. But the Taraganendal soil series is of sandy loam to sandy clayey loam. The presence of gravelliness and strong calcareousness make the land fall under the marginally suitable class. Hence, soil is the limiting factor. The Kunnathur, Kallugudi, Odaipatti mini-watersheds along the southern margins of the middle of the Upper Gundar basin their crops grow under Kottagapungulam though it is a heavy texture like Ramanujapuram series but it is severe sodicity hazard (ESP > 50 per cent) makes the suitability one grade less than S2 and brings to S3 class of marginally suitable. Hence, limitation is sodicity. The adjacent lands of Kurayur, Arasapatti, Sundarangundu, Karisalkulam mini-watersheds are confined with Perumalpatti soil series. Though the soil less grade depth, less sodicity, less gravel and many positive physical features, the low organic matter, surface
coarse texture, low fertility status keep this land under S3 class of marginally suitable.

The Palayampatti soil series is in the eastern margin Saptur mini-watershed in the Upper part of the basin comes under marginally suitable for gingelly and sunflower. As the soil series found nearer to the hill and thus shallow depth (less than 50 cm) gravelliness, soil hardness, low organic matter, low fertility status and subject to slight erosion are the major limitations reduces their suitability to marginally suitable class of S3.

LAND SUITABILITY FOR GROUNDNUT

Groundnut is an oilseed and a cash crop. A short term, 4-month crop, it is grown widely. Once it used to be a dry crop and then became an irrigated dry. Now it is grown as an irrigated crop and has several hybrid varieties in use: one each to every shade of climate. It is a crop which is grown in marginal and small holdings as well as medium and large holdings, by both the poor and rich farmers alike. The extent of cultivation is 8,480 ha or 9.8 per cent of the area for highly suitable land, 6,660 ha or 7.7 per cent of the total area for moderately suitable land, and 2,250 ha or 2.6 per cent of the total area of the basin for marginally suitable land. To an extent, groundnut is used for home consumption, for the oil extracted from the seeds is used as cooking medium. Traditionally, the Indian households have used groundnut oil for cooking food, although at present there are different oils, which are promoted for their low fat or cholesterol content. Groundnut oil is therefore becoming less popular. Market for it is not however declining, for it is also a food, the seeds are fried and eaten. The pods of groundnut are also boiled and served as snacks. It is the most popular snack for travelers, sold in small quantities at all transport terminals.
As can be seen from figure 5.5, groundnut could be grown in widely differing quality of land, from highly suitable to marginally suitable. However, in the Upper Gundar basin, groundnut is grown primarily in the head and tail end reaches. Highly suitable lands where groundnut could be grown are found distributed mostly at the head of the Upper Gundar basin and in small, scattered pockets in the tail end reach of the basin. Moderately suitable lands are on the other hand in areas adjoining the highly suitable in the head reach and in scattered pockets in both the middle and tail end reaches. Similar is the pattern for marginally suitable land but the pockets where groundnut could be grown are small in number and too widely scattered.

**Highly Suitable Land** (S1). The optimum growth of groundnut can be achieved with physical conditions that are conducive. The physical constraint, like the rainfall of 750 mm to 1000 mm, growing period of less than 120 days, flat to gentle slope, erosion may be none or slight, well-drained soil condition, more than 75 cm of soil depth, surface texture of soils like the sandy loam, sandy clayey loam, silt loam and loamy sand and pH value of 5.5 - 6.5 - are the major factors, which determine the highly suitable class. In this regard, the local context may vary. Accordingly suitability rating may also vary. In the study area, the land systems suitable for groundnut are the uplands, pediments, pediplain, shallow and medium buried pediments and deep shallow, medium and deep buried pediplain. The land of the upper reaches of the Upper Gundar basin is found to be highly suitable for groundnut.

The area is 8,480 ha or 9.8 per cent of the basin area. This class is mainly found in the Upper Gundar basin, especially in the west of the confluence of the tributaries of the Gaundan Nadhi near Sedapatti. Hence, this class is confined to
the deep buried pediplain, shallow buried pediplain, pediplain and the downstream portion of the pediments. As far as the moisture condition is concerned, rainfall must be 750 mm - 830 mm and little above. Further, the area has good depth of soil and a highly weathered zone facilitating good groundwater potential. The slope is well within the requirements of less than 3 per cent. The erosion is almost absent. The soils are the Doddapanayakkamur and Usilampatti series of loamy sand and sandy clayey loam with a soil depth of 150 cm and well-drained condition. They are fertile and fulfil the requirements. Hence, the area is under S1 category.

Another stretch covers the Sundarangundu, Arasapatti, Manthoppu, and Kallugudi mini-watersheds. In these areas of the upland plains, there are soils of the Perumalpatti (SL- SC) series with good depth, found in the vicinity of tanks and rivers. There are the major physical features that have brought the land under class S1. In these areas, groundnuts are growing under the rainfed and irrigated conditions. However, the care should be taken in drainage. Though the rainfall under this zone is between 600 mm and 700 mm, there is the moisture deficiency but overcome by well and tank irrigation.

**Moderately Suitable Land (S2).** The land under this class covers 6,660 ha or 7.7 per cent. This class of lands is adjacent to the S1 class, mainly in the upper part of the clays of the buried pediplain (based on general slope) in the upper reaches of the basin, and in the shallow buried predominant, medium buried pediment along the Gundar river in the lower and middle reaches of the basin. The soils are the same as in S1 in the upper reaches of the basin, in addition to the Perumalpatti soil series. All the soils are loamy sand to sandy loam but moisture availability is low and yet they are subject to slight erosion. The availability of moisture is less than that in the lower part of these systems.
Though the soils are good in all respects, the lack of moisture puts these lands under S2 category.

The middle and lower reaches of the basin along the river come under the shallow buried pediment and under the Taraganendal soil series of sandy loam to sandy clayey loam. The soils are free from limitations but the moisture availability is lacking leading to irrigation facility reducing its suitability from class S1 to class S2.

**Marginally Suitable Land (S3).** S3 land is mainly in the middle and lower reaches of the basin, mainly the land lying nearer the tanks. It is confined to the pediplain, and the shallow buried pediment systems. It occupies an area of 2,250 ha or 2.6 per cent of the basin area, where the soils are the Karisalkulam and Udayanendal series. These soils are sandy loam to sandy clayey loam and are suitable for groundnut. The highly calcareous nature of the Karisalkulam and the organic matter of the Udayanendal set these lands under the marginally suitable class (S3). Hence, the organic matter, and tank silts may be applied to increase the fertility and the water holding capacity of the soils.

**A Note:** The descriptions and explanations thus far have concentrated on the major crops and from now on the descriptions and explanations turn to minor crops, even if they are cash crops such as banana and coconut. The people who cultivate these crops are large landowners and are capable of generating large incomes and wealth. For reasons of marketing and competition, only a small number of these farmers may grow banana or coconut. Small and marginal farmers cannot afford to grow either banana or coconut, except for a small number of trees catering to their household needs. And there are not many large farmers or medium farmers in any given village, but they may together own more
than half the land area or more in the village. The socio-economic, water class, soils, limitations and special needs so far described have dealt with all conceivable situations and conditions such that a repeat of them in respect of other, minor crops could be redundant.

LAND SUITABILITY FOR PULSES AND MILLETS

Pulses and millets are as vital as other food crops, for all farmers, whether marginal or small and medium or large. Pulses are a daily need in all households, for they provide much required nutrition. Traditional practice is that the farmers, irrespective of size of their farms, go for pulses and millets. Pulses are often grown after the harvest of paddy and harvested in about 75 to 90 days. The pulses are not irrigated crops, but normally sown a little before paddy is harvested and while the field has enough moisture for the seeds broadcast to sprout and grow. Paddy is harvested however much before the seeds of the pulses (for example, green and black grams) sprout and grow. This way, the pulses are not expensive to grow but can be valuable in the provision of nutrition to the family.

Millets, such as ragi and cholam, are poor peoples’ staple and hence marginal and small farmers grow them, invariably. They are often drought resistant, hardy and nutritious even more than paddy. The hard working owner-cultivators and landless labourers prefer these millets as staple also because they are cheap but nutritious. Above all, they do not need irrigation and can therefore be inexpensive. Some large and medium farmers also grow pulses and millets, for commercial reasons, for they fetch good market and income to the cultivators. Medium and large farmers grow these crops on large scale and on a regular basis taking advantage of the intervening off-season periods. Ragi and cholam are now
cultivated as dry irrigated crops so that the farmers reap better yields and make commercially viable farms. While these crops demand traditional biotic and technical knowledge, they do not demand exceptional managerial skills. Small and marginal farmers take precious little care of the pulses while they may take adequate care of millets in their farms.

Figure 5.6 shows the areas where land suitability for pulses and millets is good. Pulses and millets are so versatile they grow in all land systems and lands of all too different qualities. Pulses and millets could be grown in highly suitable lands distributed in the head reaches of the basin, with a few tiny pockets in the tail end reaches (6,110 ha or 7.1 per cent of the study area). Moderately suitable lands, which could accommodate pulses and millets as crops, are found distributed very widely throughout the basin, more so in the tail end and the middle reaches of the basin (29,730 ha or 34.4 per cent of the study area). Lands, which are marginally suitable, show up throughout the basin but in smaller and smaller pockets of concentration (3,370 ha or 3.9 per cent).

**Highly Suitable Land (S1).** The requirements of pulses and millets are low rainfall of 300 mm to 600 mm of growing cycle. The distribution of rainfall throughout the growing season is more important than the total precipitation during that period. The crop is however drought resistant. The temperature ranges for their growth is 16° - 32° C, millets grow in loamy to clayey soils, lighter and heavier texture can be tolerated. The soil depth should be at least 50 mm. Well-drained, aerated soils are most suitable. Water-logging is not tolerated, and pH varies from 5.6 to 7.6. The impoverished soils with low organic matter are also suitable. Slope is flat to gentle. Soil texture may be silty clayey loam, loam, sandy clayey, sandy loam, and sandy clayey loam. If these conditions are
met, the millets can grow well and the area may be under S1 class. If the above criteria have shown increase, the land suitability will be reduced.

The land of the head reaches of the Upper Gundar basin is highly suitable for pulses and millets in an area of 6,110 ha or 7.1 per cent of the total area of the basin. It is mainly associated with the lands of the systems discussed above and in the vicinity of hilly track, especially, the Nallattevanpatti hills. These areas are composed of four soil series such as those of the Vadipatti, Peraiyur, Usilampatti and Savesapuram. These areas are flat to gentle with good drainability and rainfall and temperature are conducive during the growing cycle. The soils are also of good depth with enough moisture. The positive variables support the pulses and millets under S1. Further, almost all properties of these soils are favourable to pulses and millets; and the surface texture which is not favourable to most of the crops is also highly suitable for pulses and millets. In addition, the most favourable class of S1 with paddy is associated with this area, and thus, just before paddy harvesting, the seedlings of pulses and millets can be seen growing as the paddy lands have good moisture, which is taken advantage of.

Moderately Suitable Land (S2). Nearly all the land systems facilitate the cultivation of pulses and millets in moderately suitable lands and as many as seven soil series provide for the growth of pulses and millets, namely, the Doddapanayakanur, Ramanujapuram, Koppuchittampatti, Karisalkulam, Udayanendal, Tammasanapatti and Perumalpatti. A single crop of pulses and millets or a double crop of the same can be grown in any given area of the basin, depending upon the availability of land for such cultivation. This class covers an area of 29,730 ha or 34.4 per cent of the basin area. The topography, slope, rainfall, temperature and other physical variables are favourable but due to the
limitations of the soils, the suitability is affected, resulting in cultivation in the moderately suitable (S2) areas. The reasons are:

- Coarse texture of Doddappanayakanur soil series, as the area is located near the Saptur hills.

- Highly calcareousness of the Karisalkulam soil series.

- Alkalinity hazard, highly free CaCO₃, poor drainage and heavy texture of the Ramanujapuram, Koppuchittampatti and Tammasanapatti soil series.

**Marginally Suitable Land (S3).** The soils of the Kottagapungulam, Taraganendal and Palayampatti series are associated with the pediplain, shallow buried pediment, shallow and medium buried pediplain systems. The marginally suitable lands for pulses and millets are mainly seen in the Chandarankulam, Karisalkulam, Kallugudi, Odaipatti, Kurayur, Kunnathur, Kallugudi, Perungamanallur, Tadayampatti and Thummalpatti mini-watersheds. They cover an area of 3,370 ha (or 3.9 per cent of the total area of the basin). Though the soils have potentials to support the crops, they have constraints for growing pulses and millets. They have high gravelly nature of the Taraganendal soil series, coarse texture of the Palayampatti soil series, poor drainage, heavy texture, high free CaCO₃ and severe sodicity hazard of the Kottagapungulam soil series hindering the cultivation of these crops, as such the conditions above set the areas under marginally suitable class of S3 for pulses and millets. Hence, improvement of drainage and application of gypsum, and the use of organic matter are recommended for improving the cultivation of these crops.
LAND SUITABILITY FOR BANANA

Banana is a perennial crop. Once planted, it can continue to grow and flourish and yield every year for many years. But it is normally a two-year crop, grown over and over again in areas, which are wind-prone. It is a commercial crop and caters to a traditional practice: of eating food in the banana leaves instead of plate in social occasions and offering banana (fruits) to gods and guests. Banana is of several varieties; while some of them are appropriate for pooja (worship) in Indian customs, others are appropriate only for guests. Those in the market are those, which sell for a good price.

There is always good demand for banana, of any variety that comes to market, for it is so much in demand all the time, because of the social occasions and festivities that go on interminably. It is when there is heavy wind or heavy rain accompanying gale force winds that banana is in supply in excess of demand and the prices plunge because the quality of goods in the market is not appropriate. There is preference for banana from large, medium and small farmers but it requires investments over a year before it could yield anything and so small farmers do not often cultivate it.

However, they may have a crop in their backyard, which might considerably substitute their income from other crops, if taken care of. It is very profitable when grown in large farms and large farmers prefer therefore this crop. Medium farmers grow this crop when their economic position suits them or when they could raise loans for the purpose. Often farmers who are business people lease land and cultivate banana and make money and livelihood. Banana is thus
grown as a commercial crop. The crop may fetch approximately Rs. 30,000 to a
ha and to a year, as profit.

**Highly Suitable Land (S1).** The optimal growth and production of
banana needs physical conditions such as temperature of 25° - 28° C, altitude of
137 - 641 metres, precipitation of 1,500 mm to 2,500 mm per year, free from
wind damage, deep fertile loamy soil like the silty coarse sandy, silty clayey
loam, clayey loam and silty loam, well drained, pH 5.6 to 7.5, low sodicity, flat
to gentle slope, soil depth more than 100 cm, and irrigation at 7 - 10 days
interval. The land systems under this category of banana crop are the pediplain
and shallow and deep buried pediplain. As far as temperature is concerned, it is
adequate, it ranges between 24° to 32° C. The soil in the head reaches of the
basin, especially, the Doddapanayakkanur series of loamy sand to sandy clay
loam, is highly suitable with good groundwater conditions (Figure 5.7). Irrigation
mainly depends on wells, which are plenty in these areas. The water class is
C2S1 and is free from sodium hazard. The soil depth in this zone exceeds more
than 110 cm. Owing to these positive factors, these areas are under the highly
suitable class (S1).

However, the extent of this category of banana crop is limited to 1,880 ha
or 2.2 per cent of the basin area. Further, this zone receives rainfall of about 900
mm. In addition, supplementary irrigation is provided from the wells. As the
zone lies in the vicinity of hill tracts, the bazada and pediments, there is increase
in the groundwater potential and fertile materials are brought from the streams to
the tanks. The silt materials are used as manure. Further, the area is free from
strong winds as it is situated in the vicinity of the hills. The altitude is also
favourable with ranges between 200 metres and 250 metres and well within the
suitable range of 137 - 641 metres.
Moderately Suitable Land (S2). Except for small patches of a few land units in the tail end region of the Upper Gundar basin, banana is grown in moderately suitable land (S2) in the head reaches in 3,360 ha or 3.9 per cent of the basin area. There are land systems that permit cultivation of banana in moderately suitable land. The upland plains, pediplain, shallow buried pediment and shallow and medium buried pediplain are such lands. The water class is C3S1, which is slightly saline and free from sodium hazard. In the head reaches of the basin, there are areas generally found adjacent to the highly suitable land for banana. Though the area has many potentials, the soil types and the availability of water, and salinity of water reduce their suitability. Further, surface coarse texture, low CEC and water holding capacity, low fertility status, low organic matter content of the Usilampatti soil series bring down the suitability from S1 to S2. Hence, the area is moderately suitable for banana.

In the areas of the Savesapuram soil series, there are some constraints: the shallow depth, gravelly soil, soil hardness, low organic matter content, and low fertility which together make this region moderately suitable for banana cultivation. Hence, the soils have some limitations. These areas need application of tank silts, organic matter to maintain their suitability under S2. In Indian conditions, many varieties of bananas are available and vary in their quality according to climatic conditions. Thus, the selection of crop is most important as well.

Marginally Suitable Land (S3). Middle reaches are entirely devoid of banana in either highly suitable or moderately suitable lands. On the other hand, it is grown in marginally suitable land in the head and lower reaches of the basin. A total of 1,270 or 1.5 per cent of the total area of the basin is under marginally
suitable land for banana cultivation. The land systems where banana is grown on marginally suitable lands are the pediplain, shallow buried pediment and medium buried pediplain. These areas are found along the river courses. Hence, adequate irrigation is available. The other conditions of temperature, elevation and slope are also conducive and positive. But the soils are the Peraiyur and Udayanendal series of sandy loam to sandy clayey loam variety and are not eminently suitable. But the surface coarse texture, gravelly character, low cation exchange capacity and water holding capacity, low fertility status, and low organic matter are relatively suitable to S1 and S2 class for banana cultivation.

LAND SUITABILITY FOR COCONUT

Coconut is a long term, garden crop. It is grown, except for a few trees in the back gardens of residential houses, in large areas as ‘topes’, meaning a collective of several trees. Coconut is an inalienable part of traditional cooking that there is always market for it. In recent years, farmers have developed coconut topes, primarily in response to the lack of availability of labour for work in fields, for coconut require small number of labourers and it would be possible to provide labour from the cultivating and land owing households. Labour has become unavailable because of employment opportunities with high wages elsewhere, in construction, for example, and hence farmers have preference for long term crops, which require small number of labourers to attend to them. There is demand for coconut and the price support is good as well.

There is opportunity for exporting coconuts (as copras, or dry kernels) and as coconut oil. There is demand for coconut oil as a cooking medium. People apply coconut oil to their hair before combing it down. Some people apply it to their bodies before bathing as it has a cooling effect. And no household in the
country can excel in their culinary performance without coconut as a base. So, the demand for coconut is never diminishing. Besides, there is demand for tender coconuts throughout the year as the climate is generally hot. Coconut milk has medicinal qualities that the physicians prescribe it as part of their treatment for patients. It is also a good substitute for saline drips, where medical help would take time to be reached.

There is great market for coconut within the country. Metropolitan cities are a promising market for the crop, while small, medium and large towns in the vicinity act as intervening opportunities. It is exported to South Asian and Southeast Asian countries as well. In recent years, the Gulf countries in West Asia have become a good market for coconut products as well. Oil is also exported to the Gulf countries as well.

Figure 5.8 shows land suitability for coconut in the Upper Gundar basin. As can be seen, the area highly suitable for coconut is very limited in extent and is found only in the upper, head reaches of the basin. On the other hand, lands that are moderately suitable are found in all reaches of the Upper Gundar basin but are very limited in extent in the middle reaches and in large extent in both the head and tail end reaches. The marginally suitable lands for coconut cultivation are found mainly in the middle reaches but to a limited extent in both the head and tail end reaches. Coconut is literally found everywhere, except in lands that are not currently suitable and lands never suitable.

**Highly Suitable Land (S1).** Coconut is grown in all type soils but light to well structured, heavier soil textures are preferred. Coconut grows well on alluvial and sandy soils nearer to the coast, riverine tracts and floodplains. It is ubiquitous, found throughout India. The ideal requirements for the optimal
growth of coconut are: temperature 20° - 32° C, annual precipitation 1,000 mm and above, good soil drainage, dry season less than 3 months, soil depth 50 cm and above, pH 4.5 to 8.5 (optimum 5.2 to 7.5), flat to gentle land, flood free, silty clay loam, clay loam, sandy clay loam, sandy clay and loam. While considering these parameters, the Doddappanayakkanur soil series in the pediplain, and shallow and deep buried pediplain systems are the areas highly suitable for coconut cultivation. These lands are mainly found bordering the pediments, which is located along the foothills. In this zone, the soil has a good depth of 110 cm with loamy sand to sandy clay loam. As the water is very important factor, enough irrigation is provided by wells. The wells are highly concentrated in this zone. As such, the soil series is fertile with good drainage conditions. Though the area fluctuates in temperature from 24° C to 32° C, it is almost akin to the mean required temperature of 29° C and the area in the vicinity of hills are the positive factors for bringing these zone under highly suitable class of S1.

The area under this class is 1,290 ha or 1.5 per cent of the total area of the basin. In order to increase and maintain the soil fertility, sespania, daincha and calotropis throughout the field may be practiced once a year and can be used as green manure. Further, ash along with common salt (NaCl) may be applied around the trees covered with soil during dry seasons (so as to maintain the moisture) and organic waste, perishable fish waste may be applied during winter (to increase the nutrient) may be applied. This kind of soil management is applicable for S2 to S3 classes also.

**Moderately Suitable Land (S2).** The lands adjacent to the class S1 in the head reaches of the basin under the shallow and deep buried pediplain and pediplain, where the soil series are changing. The suitable soils under this class in the area are the Vadipatti, Peraiyur, Usilampatti and Udayanendal:
- Vadipatti soil series are akin to the constraints of that Usilampatti and Udayanendal except gravelly nature of the soil and necessity of frequent irrigation.

- Makes the area under head reaches of the Upper Gundar basin moderately suitable class.

The lower reaches of the basin are with the Savesapuram and Perumalpatti soil series in the Chandarankulam, Karisalkulam, Sundarangundu, Kallugudi, Kurayur and Arasapatti mini-watersheds. The Perumalpatti soil series is good in all respects but its coarse texture, and low fertility content, makes the tail reaches only moderately suitable. Likewise, the Savesapuram soil series occur in the mini-watersheds also under moderately suitable class, due to the shallow depth, very gravelly, soil hardness and low exchangeable potassium. The fertility and organic content of the soils generally reduce from head reaches to lower reaches whereas the alkalinity increases. Under this class, there is a total 4,840 ha or 5.6 per cent of the total area of the basin.

**Marginally Suitable Land (S3).** The Ramanujapuram, Koppuchittampatti, Kottagapungulam and Karisalkulam series in the pediplain, shallow and medium buried pediment and shallow and medium buried pediplain land systems are under marginally suitable land for coconut. The alkalinity hazard and high free CaCO$_3$, heavy texture and poor drainage of the Ramanujapuram soil series and Koppuchittampatti and severe sodicity of the Kottagapungulam series bring down the suitability class to marginally suitable (S3). All these soils are almost the same in their constraints as stated above. The Karisalkulam soil series with lands alongside the river margin are also under
marginally suitable class. The strong calcareousness of the soil reduces the suitability and keeps the lands under marginally suitable class of S3. This class covers an area about 8,250 ha (or 9.6 per cent of the total area of the basin).

LAND SUITABILITY FOR CHILLIES

Chillies are a spice crop of India. It is pungent and makes food chilli-hot, which most people like. It is medicinal when used in appropriate quantities in food preparation. This crop has a lot of demand and is an export crop as well. Local markets in and around the study area are big enough for the crop grown in the basin. Just as coconut, chillies have good market, both domestic and international. There is good support price, too. Chillies are an inevitable part of the South Indian food and preparations, it is always a preferred spice at home-cooking. It has never been a crop of excess production that the demand has always been met and with benefits to growers and buyers. There are, occasionally, seasons in which the demand may be larger than supply and as such price may be slightly high. But then, over a few weeks the prices would come down and there would be a balance. Farmers of the area are proficient in its cultivation.

From Figure 5.9, we deduce that it is a crop grown everywhere in the basin, mostly in moderately suitable lands and to a very limited extent in lands that are highly suitable (in the head reach: 4,070 ha or 4.7 per cent of the area of the basin) and marginally suitable (in all three reaches: 4,070 ha or 4.7 per cent). Lands currently not suitable and never suitable are not suitable for any of the crops: chillies are no exception. The area cultivated under moderately suitable is 32,730 ha or 37.9 per cent.
Highly Suitable Land (S1). The areas confined with four systems like pediments, pediplains and shallow and medium buried pediplains are highly suitable for growing chillies. The requirements for optimal growth of chillies are: annual rainfall 600 - 1500 mm, lower rainfall tracts, it is cultivated as an irrigated crop. The rainfed crop does well on deep, fertile, well-drained black cotton soils. Under irrigation and good manuring, excellent crops can be raised in sandy and light alluvial loams as well as in red loamy soils. In the context of the study, the Doddappanayakkanur soil series in the head reaches of the basin is highly suitable as the soil is very deep and goes up to 1,070 mm, well drained and has good irrigation potential and keeps the area under highly suitable, especially, the Madippanur, Sedapatti, Pappinayakkanpatti, Thullakuttinayakkanur, Vanderi, Mallapuram, Sulapuram, Tadayampatti, Uttapuram, Elumalai and Silanayakkanpatti mini-watersheds. These mini-watersheds have good depth of soils and good groundwater potential. Further, this area is influencing the chillies cultivation, because the potential areas are found along the down slopes of the pediments along the foothills. Thus, the soil is lighter and adequate irrigation increases its suitability. The area has numerous wells. Though the nature of the soil is such that there is low nutrient content and hence low fertility status, it is improved by adding the silt and organic matter, which are brought and spread over from the tanks. The hill tracts are under charnockite and facilitate high weathering with ferrous aluminium content. These positive factors keep the land systems above, together with the Doddappanayakkanur soil series, put these areas under highly suitable land (S1). These areas cover 4,070 ha or 4.7 per cent of the basin area.

Moderately Suitable Land (S2). This class occupies an area of 32,739 ha or 37.9 per cent of the total area of the basin. The land systems suitable under this class are the pediplains, shallow and medium buried pediments and shallow,
medium and deep buried pediplains and small pockets of pediments and upland plains. As these are distributed in all the mini-watersheds, and the soils are widely varying in types, from the. Palayampatti series (loamy sand to sandy loam), Vadipatti series (sandy loam to sandy clay loam), Peraiyur series (sandy loam to sandy clay loam), Usilampatti series (loamy sand to sandy clay loam), Savesapuram series (sandy loam to sandy clay), Ramanujapuram series (clay loam to clay), Karisalkulam series (sandy loam to sandy clay loam), Koppuchittampatti series (clay loam to clay), Udayanendal series (sandy loam to sandy clay loam) and to the Perumalpatti (loamy sand to sandy clay loam) series, the constraints to reduce the suitability from S1 to S2 are: slightly coarse texture and low cation exchange capacity of the Usilampatti and Udayanendal soil series; high calcareousness of the Karisalkulam series; shallow depth, hardness, gravelly nature, and low fertility status of the Savesapuram and Palayampatti series; alkalinity hazard, imperfect drainage, high free CaCO₃ in the Ramanujapuram and Koppuchittampatti series; low cation exchange capacity and water holding capacity, low organic matter, and low fertility of the Vadipatti, Peraiyur and Perumalpatti series. As far as groundwater potential is concerned, the head reaches of the basin has higher potential as they have good depth of the soil, which has been derived and deposited from the adjacent the hills long time ago. Though the area has these positive factors, the soil limitations set the suitability under S2 for chillies. The lower reaches of the basin areas are likely to develop alkalinity as the soils have more clayey content. Hence, the organic matter, tank silt and gypsum may be applied in the lower reaches of the basin to increase the water holding capacity and fertility rate.

**Marginally Suitable Land (S3).** The only soil series, namely, the Kottagapungulam, associated with the pediplains, shallow and medium buried pediments and shallow and medium buried pediplains systems falls under the
category. The marginally suitable land for chillies is mainly in the Chandarankulam, Kallugudi, Odaipatti, Kurayur, Kunnathur, Madippanur, Sedapatti, Perungamanallur, Thummalpatti and Tadayampatti mini-watersheds. Though the soil has good depth for growing chillies, it has limitations like the gravelly nature, severe sodicity hazard (ESP > 15 per cent), hence highly free CaCO₃, and low organic matter – all of these bring down the suitability to the marginally suitable class of S3. These areas need more summer ploughing as they are subject to soil cracks for more than 90 cumulative days and soil cover crops in order to increase the infiltration rate and moisture content. In addition, the application of gypsum will increase the water holding capacity of the soils as well. The class covers an area of 4,070 ha (or 4.7 per cent) of the basin area.

**LAND SUITABILITY FOR VEGETABLES**

Vegetables are an important component of the agricultural crops in the study area. In fact, the study area caters to the needs of the people in the basin and also in the nearby areas, essentially towns and cities such as Madurai and Virudunagar. The vegetables grown here are the local varieties and greens of different names and description and as such the brinjal or egg plant, tomato, onion, ladies finger or okra, cucumber, cabbage, cauliflower, beans, soybeans and carrot are part of the production. Vegetables are normally short term, of 3 to 5 months’ duration, while greens are even more short in duration. However, there are vegetables such as the drumstick, banana / plantain and even some of the greens, which are long term: between 2 years and 30 years. The vegetables grown here are seasonal and could thus be in demand during the season of growth and cultivation. Beyond the season, new vegetables show up in the market.
Some farmers cultivate vegetables as regular crops and are tuned to the vagaries of the vegetable market. Sometimes, the prices are beneficial and at other times the business is difficult. There is always a season of high demand, especially during the festivals and hence the vegetables are sold at prices more than during the normal period. It is in vegetables that the middlemen and merchants make good profits, as the farm gate price is far cheaper than the market gate price. Fair price of vegetables is being talked about, from time to time, but nothing to improve the prices is ever being talked about. For farmers, however, vegetables give income in quick succession, depending on how many crops are grown and for what period of the season. For farmers' households, vegetables are beyond their purchasing power. They grow and sell, and do not consume much of what they produce. Their main focus is on the money that can be earned from vegetables. Occasionally, however, they may use their vegetables and this often happens during the festivities when people indulge in some luxury on their own.

Figure 5.10 shows the distribution of vegetables and the land suitability for their cultivation. Vegetables in highly suitable lands (4,840 ha or 5.6 per cent) could only be confined to the head reaches of the Upper Gundar basin, as the highly suitable lands for vegetables are distributed here. The areal extent of the crops could be as much as a third of the area of the head reaches. Vegetables on moderately suitable lands (9,220 ha or 10.7 per cent) could be seen in the entire basin, although their extent is much restricted to the head reaches than to either middle or tail end reaches. Lands marginally suitable growing vegetables (590 or 0.7 per cent) are found only in the middle reaches of the basin and that too only to a very limited extent.
Highly Suitable Land (S1). Among the 15 land systems of the basin only two such as the pediplain and deep buried pediplain in the vicinity of the Saptur and Nallattevanpatti hills are highly suitable for vegetables cultivation. The requirements of the vegetables vary and depend upon the climatic conditions. There are more than 50 vegetable crops in India. Some grow under cool climate and some crops under warm climate. As far as the study area is concerned, the mean temperature varies between 24° C and 32° C. Hence, the vegetables in the study are of warm types. In general, light fertile soils, adequate water supply, adequate moisture and warm climate are the important variables. The water quality must be good. Some crops may be grown as salt tolerant variety.

In the study area, the Doddappanayakanur and Usilampatti soil series of loamy sand to sandy clay loam are suitable as they are light and fertile soils. In south India, the vegetables are grown throughout the year, but ideal season is July to August, that is, the season of kharif. Neither over irrigation nor insufficient irrigation is harmful to the vegetables. Irrigation is the very important factor. The area under the pediplain and deep buried pediplain with Doddappanayakanur and Usilampatti soil series has numerous wells, due to groundwater potential. The water type is C2S1. However, the water is slightly saline, but suitable for vegetable cultivation. As the areas lies in the vicinity of the hill tracts, it is under warm climate. These positive factors set the area under highly suitable land for vegetables, that is, S1.

Moderately Suitable Land (S2). Under this class, an area of 9,220 ha is moderately suitable. It is adjacent to land of the S1 and alongside the major stream courses, in the lower portion of the head reaches of the basin, and few pockets in the lower reaches of the basin. These areas are under water class C3S1, moderately saline and the soils are slightly heavier than the
Doddappanayakkanur and Usilampatti soil series. The soils are the Karisalkulam, Perumalpatti, Savesapuram, Ramanujapuram, Koppuchittampatti and Udayanendal varieties. All these soils have good depth and are non-calcareousness except for the Karisalkulam and Koppuchittampatti. The moisture content (irrigation) is less when compared to the area under S1. As these areas are located in the middle and lower reaches, there is alkalinity. Hence, the quality of water and the moisture constraints reduce their suitability to S2. The salt tolerant varieties may be cultivated, especially, the middle and lower reaches of the Upper Gundar basin. Further, uncertainty of rainfall of the southwest monsoon also is one of the reasons. During the growing period, the absence of rainfall leads to extreme dryness and subsequent damage to the crops even with irrigation. The yield is also reduced.

**Marginally Suitable Land (S3).** While analysing the soil characteristics, only the Kottapungulam series occurring in the pediplain and shallow buried pediplain is moderately suitable. This class falls under the Odaipatti and Kunnathur mini-watersheds in the middle reaches of the basin. The soil is characterised by very deep, high water holding capacity, high available potassium and high cation exchange capacity, which are the positive factors. But the heavy texture, poor drainage, very plastic clay and sodicity hazard are the major constraints, which reduce the suitability class to the marginally suitable, S3.

In general, among 17 soil series, only nine soils are suitable and fall under various suitability classes. They are the Doddappanayakkanur, Usilampatti, Karisalkulam, Perumalpatti, Udayanendal, Kottapungulam and Savesapuram, Ramanujapuram and Koppuchittampatti soils. The rest of the eight soil series are
not suitable for raising vegetables. Hence, the land under different suitability for vegetables is restricted to 590 ha.

LAND SUITABILITY FOR FRUIT TREES
(Mango, Guava, Sapodilla)

Farmers who know the value of fruits as nutrition supplements have long cherished fruit trees as crops. Although fruit trees have been grown only as a few clumps of trees in the backyard of the houses for long, in recent years, the farmers have tended to grow them as garden crops, realising their commercial value. For several of them, these have now become their livelihoods and they are making out in life better than before. Tree plantations are now a common sight and farmers plan for more of such gardens as they fetch better yields, prices and income. These are but small in number and yet small in scale of operation. There is potential for it to catch up in the next few years as large-scale operations and hence the land suitability for the fruit trees.

Fruits of any description have market value in the study area as well as in the adjacent areas. There is much demand in the urban markets than in the rural markets. Festivals, social occasions, and cultural events call for fruits to be bought and distributed and hence there is demand for the seasonal fruits and through the year.

Figure 5.11 shows the land suitability for fruit trees and the distribution is quite mixed. Fruit trees could be grown almost everywhere in the basin. But the crops could be found concentrated in the head reaches in the highly suitable lands, with a limited extent of it found in the tail end reaches, north of the Gundar river. Fruit trees in the moderately suitable lands are distributed mostly
in the floodplains and the distribution is predominantly in the tail end and in the middle reaches. A tongue of the cropped area goes into the head reach but not deep into it. Fruit trees grown in marginally suitable lands are found distributed all over the basin, with only a limited extent in the head reach.

**Highly Suitable Land (S1).** The lands in the uplands, pediment, pediplain, shallow and medium buried pediments and shallow, medium and deep pediplains are the highly suitable areas. For optimum growth of mango, the physical potentials are: temperature ranges between 15° and 40° C, and optimum temperature 22° and 28 °C. The precipitation between 1,000 mm and 2000 mm per year, pH 5.5 to 7.8, slope condition plain to undulating, good drainability, loamy, silty loam, sandy loam, sandy clay loam and sandy clay the depth of the soil 100 cm to 150 cm. As these variables are conducive, especially, in the pediments, pediplains, shallow and deep buried pediplains with soil series of the Vadipatti (sandy loam to sandy clay loam), Peraiyur (sandy loam to sandy loam), Usilampatti (loamy sand to sandy clay loam) and Doddappanayakkandur (loamy sand to sandy clay loam), fruit trees are confined to these areas. Besides, the soils have depth of 150 cm in these areas. pH value also within the optimum level. As the area has a mean temperature of about 29° C, which is well within requirements, the location bordering along the hill tracts facilitate moisture content in the form of 5 per cent of seepage of rainfall of from the hilly areas. These are favourable features for keeping these areas under highly suitable class (S1). It should be mentioned that these crops are generally cultivated under rainfed conditions in the study area. These lands cover an area of 13,450 ha or 15.6 per cent of the total area of the basin.

**Moderately Suitable Land (S2).** This class covers an area of 9,890 ha (or 11.4 per cent) of the total area of the basin. Under this, there are as many land
systems as in the highly suitable category. But the nature of the soil, especially, along the streams and rivers is different. While going through the soil types only three soils are suitable under this class, namely, the Karisalkulam of sandy loam to sandy clay loam, Udayanendal series of sandy loam to sandy clay loam and Savesapuram series of sandy loam to sandy clay. The soil types of sandy loam to sandy clayey loam and sandy loam to sandy clay are fulfilling the requirements. The depth of these soil series ranges between 50 cm and 80 cm. The very gravelly nature and soil hardness of the Savesapuram soil series, strong calcareousness of the Karisalkulam series, low water holding capacity, low organic matter, low cation exchange capacity and low fertility status of the Udayanendal series are the major constraints, which reduce the suitability to S2. Further, as the areas are located in the vicinity of stream courses and mainly in the plain area, the drainability is moderate. This is also one of the reasons for class S2. However, though moisture content is not like that in the head reaches of the basin, the available moisture in the vicinity of the stream courses support the suitability under S2 class for these crops.

**Marginally Suitable Land (S3).** The lands under this class are generally located away from water sources (tanks and rivers). The rainfall is less than 600 mm. No irrigation is available. These are the reasons for suitability under S3 in the middle and tail end reaches of the Upper Gundar basin. This class covers an area of 17,350 ha or 20.1 per cent of the basin area. In addition to that, the soils are the Palayampatti, Ramanujapuram, Koppuchittampatti, and Kottagapungulam series. The Palayampatti series are as much as the Savesapuram series in character and hence the shallow depth, and soil hardness in the dry pockets are the major constraints. The other soils have good depth, high water holding capacity, high cation exchange capacity and high available potassium. Though these soils are with their potentialities, they have the major constraints like the
alkalinity hazard, poor drainage, and very sticky plastic clay natures of the Ramanujapuram, Koppuchittampatti and Kottagapungulam soil series, which reduce the suitability and put them under S3. Further, the Kottagapungulam is subject to severe sodicity hazard. All the soils are subject to cracks during summer for 90 cumulative days and thereby the reduction in soil moisture. All these limitations get these areas under marginally suitable for mango / guava / sapota. More summer ploughing is needed to increase the moisture content and water holding capacity along with the adding of the gypsum.

OPTIMUM UTILISATION OF LAND

Figure 5.12 illustrates the areas highly suitable for all crops. The optimum utilisation suggested by the analysis and mapping of data in terms of the reaches suggests that the head reach has the larger concentration of the highly suitable areas, whereas the middle and tail end reaches have scattered areas and limited concentration of the highly suitable areas for all crops. From the study, it is also seen that a large proportion of the area, especially those of the currently not suitable and never suitable cannot be brought under cultivation, unless land reclamation efforts are carried out on a war footing. There is a process of wasteland making must be recognised as well.

Agro-forestry occupies the highly suitable area for an extent of 24,020 ha or 27.8 per cent of the geographical area of the basin. In wasteland development, however, agro-forestry should be an option as it is already being introduced and used in the area for restoring the environment.
WASTELAND DEVELOPMENT: PROPOSED LAND USES

Figure 5.13 is a map showing the proposed land uses for wasteland development. This map shows what crops could be grown and where, using codes for tree crops. It must be emphasised that the lands currently not available for cultivation and lands never suitable for growing crops are considered for suggestions. They mainly cover long fallow lands, lands with or without scrub, water logging and so on. In order to bring these areas under agricultural farming, four different categories of uses are suggested. They are: agro-forestry, economic plantation, energy plantation and horticulture. It is important to note that any given land unit is suitable for not just one type of crop but for a variety of crops and as such the codes are multiple rather than single.

- Under agro-forestry, tree crops like the neem (N), palmyrah (P), pungam (Pu), silk cotton (S) and tamarind (T) are suggested as these are of medicinal and commercial value besides being important for timber/lumber and wood for fuel as well.

- Economic plantation includes bamboo (B), casuarina (C), eucalyptus (E), odai (O), and teak (Te).

- Energy plantation includes acacia of at least two varieties, namely, karuvel (K) and mankaruvel (M), prosopis (Pr) and velvel (V). It must be pointed out that casuarina or what is popularly known as the switch wood is a fuelwood. Trees of energy plantations grow everywhere, even while water scarcity due to scanty rainfall is acute. People pick their twigs and dead branches for fuels and the trees (for example, acacia – karuvel) are
good for making wooden implements such as the plough and hoe and pickaxe handles.

- Horticulture trees are cashew (Ca: good for sandy and semi-arid areas), custard apple (Cu), guava (G), jack (J: good for underground water potential), mango (M), and wood apple (W). Some of the fruit crops would however require improvement to the soil and replenishing of the nutrients, time and time again, to be of any use for the crops.

A good many useful practices need to be suggested to the farmers by the experienced farmers themselves. The land uses could take advantage of 3,660 ha or 4.2 per cent of the total area. Energy plantation could be developed in about 5,440 ha or 6.3 per cent of the total area.

The proposed land uses above, by introducing various tree crops for the wasteland development, are land units specific under different mini-watersheds of the Upper Gundar basin. Apart from this, with reference to the resource development of the basin, the land use pattern and their spatial assemblage, in general, the strength and crackness of each facet of land, impinge on the present land utilization types, and the suitability based on potentialities and constrains. The study has observed that the general land suitability for the wasteland development, with reference to the nature of soil and their occurrence over the land systems, could be dealt with in the following manner. In addition to that, while going through the rough soil reports of Tamil Nadu, some of the common natural vegetations observed for the same soils occur in the Upper Gundar basin. Hence, the study proposes the following:
Tree crops suitable for shallow soils. In the present context of the study area, the shallow soils like those of the Valayapatti, Maripatti, Nagamalai and Savesapuram series are associated with the pediment areas bordering the Nallattevanpatti and Saptur hills in the western margin of the Upper Gundar basin, except for the Savesapuram series which occur in the upland plains, come under class. The sandy to gravel loamy of the Valayapatti series, loamy sand to sandy loam of the Maripatti and Nagamalai series, sandy loam to sandy clay of the Savesapuram series are under shallow depth ranges between 50 m and 80 cm along the tracts. The Valayapatti and Maripatti soils have shallow depths, severe stoniness of the surface, and a very gravelly substratum subject to erosion. The characteristics of the Nagamalai series are almost akin to the Valayapatti and Maripatti series but they are characterized by slightly deeper soils, and very gravelly and stony surface. The Savesapuram series is characterised by shallow depth, very gravelly subsoil, and soil hardness. Owing to these characteristics and shallow depth of the Vagai, Odai, Aacha, Palmyrah, Perumaram, and Seemaikaruvel, there are suitable tree crops which could be grown economically and also efficiently in environmental restoration.

Tree Crops Suitable for Black Cotton / Clay Loamy to Clayey Soils. The Ramanujapuram, Koppuchittampatti, and Kottagapungulam soil series are clay loam to clayey. They have a heavy texture, imperfect drainage, very sticky plastic clay, low infiltration rate, and low organic matter. These soils are mainly confined to the pediplains, bordering the streams and major rivers. At present, these areas either under fallow or under wastelands category like the land with or without scrub. They cover a larger area in areal extent. These soils are best suited for neem, tamarind, aaba bul, karuvel, and seemai karuvel.
Tree Crops Suitable for Water Stagnating and Draining Lands alongside the Stream Courses and the Tanks. The land systems along the river course are the shallow and medium buried pediments and shallow and medium pediplains associated with the Udayanendal, Karisalkulam, and Taraganendal series of sandy loamy to sandy clay loam. These soils are deep, well drained and have many potentialities. But as they are located along the waterfront, the soils of these areas are under water logging as well. However, these streams and rivers are rainfed and the area is semi-arid. Hence, the water logged area has dried up for some time. Hence, these areas are suitable for bamboo, marudhu, naval (blue berry), karuvel (country acacia),

Tree Crops Suitable for Waterlogged Area. The land systems like the shallow and medium buried pediments and shallow and medium buried pediplains are subject to water logging along the river courses in the plains. It should be noted that the catchment areas of the tanks closer to the rivers are often subject to water logging for considerable periods, especially, during northeast monsoon. The suitability of soils is not a constraint but water logging is the major constraint; hence, these areas may be planted with karuvel only.

Tree Crops Suitable for Sandy / Sand Sheet Areas. Among the 15 land systems, the sand sheet systems are found along the Gaundan Nadhi (river) courses, especially, in Naduvankottai mini-watershed. The sands are eroded and washed materials brought down by the rainwater from adjacent areas where the Taraganendal and Karisalkulam soil series are common. These areas are suitable for casuarina.

Tree Crops Suitable for Sheet Erosion Area. The suitable tree species are the seemai karuvel (prosopis) and aacha. The systems occur at nine places.
The total area is 1,040 ha. It accounts for 1.7 per cent of the total area of the basin. The land units are varying from 10 ha to 120 ha. A total of 36 land units occur. These systems are seen in the Odaipatti, Sengapadai, Appakarai, Perungamanallur and Thummalpatti mini-watersheds. The elevation ranges between 102 metres and 204 metres and the slope is gentle. This system is either fallow or under land without scrub / barren. The systems are mostly confined to the Karisalkulam, Taraganendal, Koppuchittampatti and Kottagapungulam soil series. These soils are subjected to erosion due to slope and uncultivable land. These areas may be planted with scrubs and trees or with grass species like the *Vetiveria Zizaloides*, and *Genghgs Giliaris*. In the present context, the *Vetiveria Zizaloides* may be highly suitable as these grow faster with interwoven roots. Further, it will retain moisture in the soil for a longer time, followed by planting the trees wherever possible. Simultaneously, stabilisation of soil is also essential.

**Tree Crops Suitable for Strong Calcareous of the Karisalkulam Soil.**
The Karisalkulam soil series occurs along the river courses, especially, in the middle and tail reaches of the basin, subject to strong calcareousness under the pediplains, shallow and medium buried pediments and shallow and medium buried pediplains systems. The alkalinity exceeds more than 8.5, and such areas may be suitable for growing eucalyptus, *karuvel*, neem, *velvel*, *soundan*, *seemai karuvai* and *ilupai* (soapnut).

**Tree Crops Suitable for Pediment Areas bordering the Hill Tracts.**
The pediments bordering the Nallattevanpatti and Saptur hills are associated with soils such as the Karisalkulam in the Perungamanallur mini-watershed, the Palayampatti series in the Eramarpatti, Tadayampatti, Mallapuram, Sulapuram, Uttapuram and Silanayakkanpatti mini-watersheds, the Usilampatti series in the Vanderi, Thullakuttinayakanur and Mallapuram mini-watersheds. These soils
have good depth and are red soils as they are associated with charnockite. The weathered and washed materials with ferrous aluminum content make the soil red in colour. This deeper soil is highly suitable for cultivation but the slope and topography conditions hinder the cultivation. Hence, these areas may be planted with the eucalyptus, neem, vagai and cashewnut. The red soils are highly suitable for cashewnut cultivation.

Summary

The chapter has dealt with the Land Suitability Classification of the Upper Gundar Basin. There has been a detailed description of the land systems, land units and area, soil series, existing land uses, land characteristics, suitability classes for eleven crops and wastelands. The purpose of the land suitability classification has been to explicitly display the crop-specific land suitability classification and the classes of suitability over which the crops could be grown with benefit.

For cropping, it has intrinsically been assumed that the land currently not suitable and land permanently not suitable need not be considered under cropping and in the analysis of the land suitability classes, across the mini-watersheds and land systems. Paddy is one crop that has been found to have all classes of suitability and the land systems like the shallow and medium buried pediplain, shallow and medium buried pediments and valley fills have been found to have land only marginally suitable where the soil series are the Koppuchittampatti, Karisalkulam, Savesapuram, Udayanendal, Ramanujapuram, Kottagapungulam, Vadipatti and Peraiyur. All these soils are suitable for paddy as good as the soils class S1 but their soils have few constraints like the alkalinity.
hazard of the Ramanujapuram soil series; and the strong calcareousness of the Karisalkulam soil series.

In the Upper Gundar basin, the lands confined to the pediplain, shallow and deep buried pediplain, systems have been found highly suitable for growing sugarcane. In deep clayey loamy soil, irrigation interval is 2 - 3 weeks. The lands adjacent to the S1 class have been with other soil groups like the Usilampatti and Udayanendal. Both these soil series are from the family of the Doddappanayakkannur soil series. The soil series is one of the important factors determining the suitability class for cultivating sugarcane. Shallow depth of less than 50 cm, general hardness of soil, low fertility of the Savesapuram and Palayampatti soil series are found to be the limitations of the class of suitability for sugarcane. Good drainage conditions are needed in the Ramanujapuram and Koppuchittampatti soil series if sugarcane has to be beneficially grown.

The lands highly suitable for cotton require more summer ploughing and soil cover crops. On the other hand, the lands suitable for cotton under S2 class have good, potential soils. The soils found in the marginally suitable class are the Palayampatti (loamy sand to sandy loam), Vadipatti (sandy loam to sandy clayey loam), Peraiyur (sandy loam to sandy clayey loam), Savesapuram (sandy loam to sandy clay), Kottagapungulam (sandy clayey loam to sandy clay), Taraganendal (sandy loam), Perumalpatti (loam sand to sandy clayey loam) and Tammasanapatti (sandy loam to sandy clay loam). The little moisture and cracks during summer necessitate soil cover crops, which are most important, especially in marginally suitable lands.

Gingelly and sunflower are the crops that can thrive well in a variety of soils. They perform well, neutral and well-drained light soil as well as heavy
soils. The soil series under the moderately suitable class are different from soils under this marginally suitable class. The soil series under marginally suitable class are the Palayampatti, Kottagapungulam, Taraganendal, Perumalpatti and Tammasananapatti. The land is mainly associated with single crop areas under rainfed conditions. The soils are the Doddappanayakanur and Usilampatti series of loamy sand and sandy clayey loam with a soil depth of 150 cm and well-drained condition are highly suitable for groundnut. The land under moderately suitable class for groundnut covers 6,660 ha or 7.7 per cent of the geographical area of the basin. The middle and lower reaches of the basin along the river come under the shallow buried pediment and under the Taraganendal soil series of sandy loam to sandy clayey loam and support the groundnut crop as the moderately suitable land. S3 land for groundnut has been found to occur in the middle and lower reaches of the basin, mainly the land lying nearer the tanks.

Pulses and millets are so versatile they grow in all land systems and lands of all too different qualities. The soil depth should be at least 50 cm. Well-drained, aerated soils are most suitable. The impoverished soils with low organic matter are also suitable. Soil texture may be silty clayey loam, loam, sandy clayey, sandy loam, and sandy clayey loam. Banana is a perennial crop. Banana has been grown as a commercial crop. The land systems under the highly suitable class for banana crop are the pediplain and shallow and deep buried pediplain. There are land systems that permit cultivation of banana in moderately suitable land. The upland plains, pediplain, shallow buried pediment and shallow and medium buried pediplain are such lands. In the areas of the Savesapuram soil series, there are some constraints: the shallow depth, gravelly soil, soil hardness, low organic matter content, and low fertility which together make this region moderately suitable for banana cultivation. Hence, the soils have some limitations.
The land systems where banana has been grown on marginally suitable lands are the pediplain, shallow buried pediment and medium buried pediplain. Coconut is grown in all type soils but light to well structured, heavier soil textures are preferred. The lands adjacent to the class S1 where coconuts are grown are in the head reaches of the basin under the shallow and deep buried pediplain and pediplain, where the soil series are changing. The Ramanujapuram, Koppuchittampatti, Kottagapungulam and Karisalkulam series in the pediplain, shallow and medium buried pediment and shallow and medium buried pediplain land systems are under marginally suitable land for coconut. The Karisalkulam soil series with lands alongside the river margin are also under marginally suitable class. The strong calcareousness of the soil has reduced the suitability and keeps the lands under marginally suitable class of S3.

Chillies are a rainfed crop, which has done well on deep, fertile, well drained black cotton soils. The Palayampatti series (loamy sand to sandy loam), Vadipatti series (sandy loam to sandy clay loam), Peraiyur series (sandy loam to sandy clay loam), Usilampatti series (loamy sand to sandy clay loam), Savesapuram series (sandy loam to sandy clay), Ramanujapuram series (clay loam to clay), Karisalkulam series (sandy loam to sandy clay loam), Koppuchittampatti series (clay loam to clay), Udayanendal series (sandy loam to sandy clay loam) and to the Perumalpatti (loamy sand to sandy clay loam) series have shown constraints for the cultivation of chillies and have reduced the suitability from S1 to S2, because of the slightly coarse texture and low cation exchange capacity of the Usilampatti and Udayanendal soil series; high calcareousness of the Karisalkulam series; shallow depth, hardness, gravelly nature, and low fertility status of the Savesapuram and Palayampatti series; alkalinity hazard, imperfect drainage, high free CaCO₃ in the Ramanujapuram
and Koppuchittampatti series; low cation exchange capacity and water holding capacity, low organic matter, and low fertility of the Vadipatti, Peraiyur and Perumalpatti series. Lands currently not available for cultivation and lands never suitable for growing crops have been considered for suggestions. The proposed land uses for wasteland development focus on introducing various tree crops under different mini-watersheds of the Upper Gundar Basin.