DEVELOPMENT OF SPATIAL CROP SUITABILITY MODEL THROUGH PARTICIPATORY AND INTEGRATED LAND EVALUATION FOR SUSTAINABLE AGRICULTURE

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IN THE NAME OF ALMIGHTY,
THE MOST BENEFICIENT,
THE MOST MERCIFUL

DECLARATION

I hereby declare that this thesis entitled **"Development of spatial crop suitability model through participatory and integrated land evaluation for sustainable agriculture"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

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CERTIFICATE

Certified that this thesis entitled **"Development of spatial crop suitability model through participatory and integrated land evaluation for sustainable agriculture"** is a record of research work done independently by Mr. K. Abdul Samad under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.

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INTRODUCTION

1. INTRODUCTION

Indian agriculture is known for its multi-functionalities of providing employment, food, nutritional and ecological securities. Agriculture sector alone sustains around 64 per cent of the country's population. Similarly, at present agriculture and allied activities contribute to about 29 per cent of the gross domestic product as compared to 2 per cent in U.S.A., France, Norway and Japan, 5 per cent in the case of Korea and 49 per cent in the case of Ethiopia. Inspite of substantial increase in food grain production, the rate of increase in population demands higher food production. This has to be achieved by maintaining harmony with the environment, which is the core principle of 'sustainable agriculture'. In the words of Swaminathan (1991) "Intensive cultivation of land without conservation of soil fertility and soil structure would lead ultimately to the springing up of deserts".

Demographic changes and economic growth exert strong and competing pressure on the finite natural resources. In India the net area devoted to agriculture is shrinking day by day due to various reasons. The size of land holding is becoming smaller and smaller. The 'waste land' is on the increase, mainly due to poor returns and the risk aversion of the people. Shiva (2002), reported that Indian farmers are spending more than Rs.1.32 trillion on seeds and chemicals under the globalisation regime. Considering these aspects, sustainable solution to hunger and poverty is possible only through the promotion of ecological, organic, biodiverse small farms which conserve the natural resource, use low cost and locally adaptable technologies.

1.1 NEED FOR SUSTAINABLE AGRICULTURE

The type of land utilization varies from place to place. This is due to the difference in type and nature of interactions between various biophysical, environment, social and economic factors. In the past, land use changes often came by gradual evolution as a result of separate decisions taken by individuals. At present in the crowded and complex world, they are frequently brought by the process of 'land use planning'. The function of land use planning is to guide decisions on land use in such a way that the available resources are put to the most beneficial use of man-kind both in terms of short term and long term perspectives.

Exploitation of a piece of land to an undesirable use would lead to its degradation and render it unsuitable for the future. Dhruva and Babu (1983) estimated that 5334 million tonnes of top fertile soil are being eroded annually due to water erosion in India. The situation in other parts of the globe is also not much different. Buringh (1989) estimated about 15 to 30 per cent decline in world food production over twenty five years due to land degradation problems. As defined by the FAO (1989), sustainable agriculture is the successful management of the resources for agriculture to satisfy the changing human needs while maintaining or enhancing the quality of environment and conserving the natural resources.

Food security and social security are the two vital linkages of stability and well being of man-kind. Any one who has concern for the 'mother earth' and 'future generation' cannot be a silent spectator to the excessive greediness of certain human beings for mere economic motives at the cost of our food and social security. According to estimates annually 0.8 per cent of the prime agricultural land are being converted for urbanization in India. Similarly, conversion of the fragile wet lands even to rubber plantations in Kerala is another example for man's excessive greediness.

Unscientific agriculture has resulted in soil erosion and other resource degradation problems. Abrol (1994) reported that 18 per cent of the world's top soil is lost annually due to erosion. These aspects formed some of the focal themes of the UN World Submit for Sustainable Development at Johannesburg during 2002. In the present state of development process taking place, it is expected that the problem of food security and poverty may become acute for future generation in many parts of the world. It is estimated that India may need more than 300 million tonnes of food grain by 2025 AD. This target has to be achieved without detrimental effects on environment, that is through a system of sustainable agriculture.

As reported by McNeill (2000), it was the Report of the World Commission on Environment and Development (the Brundtland Report) published in 1987, which brought in the terminology of 'sustainable development'.

Sustainability highlights the importance of appropriate allocation of limited resources at par with efforts for maintaining and expanding the resource base itself. This needs proper evaluation of the resources in terms of its problems and potentials. According to Venkataraman (2002), the future growth in agriculture have to necessarily come from increased productivity from a shrinking natural resource base through efficient management. Simultaneously conservation of natural resource must receive sustained attention. He also pointed out that our vision for growth should not be clouded by short-term gains, but must strongly focus on long term sustainability. In the words of Kumaraswamy (2003), "the philosophy of sustainable agriculture is to maximise crop production through scientific methods of farming, growing crop varieties for high yielding and high quality potential and using optimum inputs of manures, fertilizers, biofertilizers and agricultural chemicals without exploiting and polluting the natural resources of soil, water and environment. Sustainable agriculture must be in harmony with the environment without exploiting and exhausting the natural resources".

Considering all these aspects the sustainable solution to hunger and poverty is possible through the promotion of a sustainable farming system which conserve the natural resource and also use low cost and locally adaptable technologies.

1.2 LAND EVALUATION FOR SUSTAINABLE AGRICULTURE

The demands placed on finite land resources is increasing exponentially. To meet this need and also to maintain the productivity of land, there is no alternative, except to manage the land resources more effectively than at present. It is the function of land evaluation to bring out such an understanding and to present to the stakeholders of land resources with comparisons of the most promising kind of land use, crop suitability etc.

Any agricultural development activity to be made sustainable needs proper land evaluation. This will help for resource based planning process in crop selection and its management appropriate to each locality. Land evaluation involves the basic surveys of physiography, hydrogeomorphology, soils, vegetation, climate, socio-economic conditions etc. of an area. According to Beek (1981), these data are potentially useful to the farmers, planners, administrators and decision-makers. He also pointed out that many a times these people are not trained to use them. Hence the awareness, knowledge and attitude of these people towards the concept, techniques and utility of land evaluation for agriculture development is important.

Land evaluation for sustainable agriculture development can be best envisaged through the concept of watershed management. According to Sivanappan (2002) watershed has become an acceptable unit of planning for optimum use and conservation of soil and water resources. He also opined that it will help in preventing degradation resulting from interaction of physiographic features, it eliminates unscientific land use / inappropriate cropping pattern and reduces soil erosion, thereby improving the sustainable productivity of the land resources. Watershed management helps in enhancing the ground water recharge and also restoration of the eco-system.

Such a management system has great relevance in land use planning for a state like Kerala with diverse agro-ecological situations, high cropping intensity, high population density, high intensity of rainfall, undulating to steep topography etc. Moreover it is noticed that watershed development projects in general had a positive socio-economic impact on the farming community in Kerala.

In land evaluation, the biophysical parameters will be assessed in terms of their problems and potentials in order to adopt a particular land use or cropping pattern. In this exercise the technology of remote sensing can provide timely and reliable information. Rao (1991), opined that satellite remote sensing can provide realistic and timely data of the resources and hence it will provide unique support to increase agricultural productivity. Land evaluation for agriculture merely on the basis of one or two biophysical parameters do not yield realistic results. Land evaluation, considering the biophysical and socio-economic factors, is essential for sustainable agriculture development in the present context. This is termed as integrated land evaluation. The procedure of considering the biophysical factors alone for land evaluation did not yield the desired results and acceptability of the stakeholders of land. This gave rise to the concept of integrated land evaluation. This concept of land evaluation for crop suitability was introduced by FAO since mid seventies and updated periodically. Here the biophysical, social and economic factors are given due considerations.

The sustainable utility of natural resources can take place only with the acceptability of the people. According to Mukherjee (1997), this needs the involvement of beneficiaries in resource evaluation for decision making. Such an effort can be termed as 'participatory land evaluation'. Ramulu (2002) emphasised that the people for whom development programmes are meant must be involved in the process of planning and execution. It helps to yield vital information on local level problems and potentials. Land evaluation through participatory and integrated approach is a more realistic technique in deriving 'crop suitability' recommendations for location specific planning leading to sustainable agriculture development. Hence the present study had great relevance in the context of sustainable agriculture development.

1.3 OBJECTIVES OF THE STUDY

1. To identify the most important biophysical and socio-economic factors to be considered in participatory and integrated land evaluation for crop suitability aimed at sustainable agriculture development.

2. To measure the awareness of Agricultural Officers on land evaluation for sustainable agriculture development.

3. To measure the knowledge level of Agricultural Officers on land evaluation for sustainable agriculture development.

4. To measure the attitude of Agricultural Officers towards land evaluation for crop suitability.

5. To study the relationship of selected profile characteristics of Agricultural Officers with their awareness, knowledge and attitude towards land evaluation for sustainable agriculture development.

6. To develop ‘spatial crop suitability model’ through participatory and integrated land evaluation at micro watershed level in a selected area.

7. To assess the likely utility of the spatial crop suitability model as perceived by the farmers of the study area.

1.4 SCOPE OF THE STUDY

Sustainable agriculture development through resource based planning helps in productivity enhancement, optimum use of available resources and environment conservation. The practical utility of this study is substantial. This is a pioneering study of its kind, wherein an attempt has been made to develop a method of deriving spatial crop suitability recommendation through participatory and integrated land evaluation at micro watershed level in Kerala. This will help the Department of Agriculture to streamline its activities from the present style of ‘sectoral planning’ to ‘resource based planning’ for grass roots level development in Kerala. The study will also help in assessing the scope of remote sensing technology and GIS for delineation of micro watershed and in evaluating the land resources for location specific planning.

Scientific contribution of the study has helped in identifying the most important biophysical, social and economic factors for participatory and integrated land evaluation at micro watershed level in Kerala. The present methodology of deriving the 'spatial crop suitability model' can be used as a guideline in deriving similar models for other parts of the State. Similarly the measurement devices developed for the study are an addition to the body of research in agricultural extension. Overall, it is hoped that the findings will serve as an eye opener for attempting location specific research and development as envisaged in the National Agricultural Policy-2000.

1.5 LIMITATIONS OF THE STUDY

As the study formed part of the doctorate degree programme, time, infrastructure, finance and other resources at the disposal of the researcher were limited. These limitations restricted the selection of the study area, sample size etc. In a study of this nature, one cannot hope for a comprehensive and exhaustive analysis. However, careful and rigorous procedures have been adopted to carry out the study as objectively as possible.

Only the response of prime and critical users of land evaluation in Kerala, namely Agricultural Officers and farmers have been considered in this study. As the conative response of farmers to the developed model cannot be studied within the limited time, their perceived likely utility was studied from their response towards the spatial crop suitability model in land evaluation for crop suitability.

1.6 ORGANISATION OF THE STUDY

The thesis is presented in five chapters. The first chapter of 'introduction' highlights the problems, objectives, scope and limitations of the study. The second chapter 'theoretical orientation' deals with the definitions, concepts and related findings of the study. The third chapter 'methodology' encompasses the details on selection of study area, sampling, procedures for data collection, interpretation of the parameters for land evaluation, empirical measures used, statistical tools used etc. In the fourth chapter, the results of the study in relation to the objectives with interpretation of findings and their discussion are presented. The fifth chapter summarises the study highlighting the salient findings.

THEORETICAL ORIENTATION

2. THEORETICAL ORIENTATION

This chapter aims at developing a theoretical framework on the concept of 'land evaluation' particularly 'participatory' and 'integrated' land evaluation and its use in developing 'spatial crop suitability' model for sustainable agriculture development. This has been attempted on the basis of definitions, ideas, concepts and past studies related to the topic gathered from available literature.

Research studies directly relating to participatory and integrated land evaluation in the context of micro level planning were penurious in their availability. However, maximum effort was taken to attempt the review of literature on land evaluation, participatory approaches and related aspects to the extent possible. In this chapter an attempt has been made to present the available literature directly or indirectly related to the topic under the following major heads.

2.1 Concepts and factors related to participatory and integrated land evaluation for sustainable agriculture.

2.2 Awareness of Agricultural Officers on land evaluation for sustainable agriculture development.

2.3 Knowledge of Agricultural Officers on land evaluation for sustainable agriculture development.

2.4 Attitude of Agricultural Officers towards land evaluation for crop suitability.

2.5 Relationship of selected profile characteristics of Agricultural Officers with respect to their awareness, knowledge and attitude towards land evaluation for sustainable agriculture.

2.6 Development of 'spatial crop suitability model' at micro water shed level for sustainable agriculture.

2.7 Perception of farmers on the utility of the spatial crop suitability model for sustainable agriculture.

2.1 CONCEPTS AND FACTORS RELATED TO PARTICIPATORY AND INTEGRATED LAND EVALUATION FOR SUSTAINABLE AGRICULTURE

FAO (1976) defined the concept of land utilization types and suggested the classification of land for specific purposes. Here classification is presented in orders, classes, sub-classes and units. Orders are 'S' and 'N' (S-Suitable; N-Not suitable), Classes are S_1, S_2 and S_3 under 'S' and N_1 and N_2 under 'N'. Sub-classes reflect the kinds of limitation with in classes such as erosion, water deficiency etc. and the units reflect the sub division of sub classes based on their response to management. The final outcome of land evaluation is a number of clear recommendations with alternatives on appropriate types of land use together with their consequences. Land evaluation provides data on the basis of which land use decisions can be taken. The rational approach to land evaluation is to carry out systematic surveys of the land resources, evaluating their potentials or suitability for a wide range of land use options, formulate land use or crop suitability plans appropriate to the locality and also which is sustainable. This can be done at any scale, namely individual farms, regional or national level. There are two aspects to such an evaluation. One is to avoid the hazards stemming from physically unsuitable land use such as cultivation on slopes that are too slopy and other is to optimise the pattern of land use such as selection of appropriate crops to get the best overall returns on a sustainable basis.

According to Dent and Young (1981) land evaluation is the process of estimating the potential of land for alternative kinds of use. These include productive uses such as aerable farming, livestock production, forestry etc. together with uses that provide services or other benefits such as catchment area protection, recreation, tourism, wildlife conservation etc. As defined by the FAO (1983), land evaluation is the assessment of land performance when used for specified purposes. The first attempt of land evaluation was carried out in California during 1933 for taxation purpose. Later this was used for agricultural related activities.

In planning for rural development, land evaluation forges a link between the basic surveys of resources and decision taking of land use planning and management. The main objective of land evaluation is to put at the disposal of the users, namely farmers, planners, administrators or politicians the relevant information about land resources that is necessary for planning, development and decision making.

According to the FAO (1983), the principle objective of land evaluation is to select the optimum land use for each defined land unit, taking into account the physical, socio-economic factors and also conservation of the resources for future generations. Accordingly, the 'frame work for land evaluation' was formulated by the FAO based on the following six principles.

i) Land suitability is assessed with respect to specified kind of use.

ii) Evaluation requires a comparison of the outputs obtained and inputs needed on different types of land.

iii) An inter disciplinary approach is required.

iv) Evaluation is made in terms relevant to the physical, economic and social context of the area concerned.

v) Suitability refers to use on a sustainable basis.

vi) Evaluation involves comparison of more than one kind of use.

Different researchers or organisations have used different methods of land evaluation for agriculture development. Riquuier *et al.* (1970) developed a simple method of land evaluation. In this method land indices were compared with classes defined as poor, average, good, very good and excellent. The FAO (1983) has developed guidelines of land evaluation for rainfed agriculture. As reported by the FAO (1987) the seventh meeting of the East and South African sub-committee for soil correlation and evaluation held at Botswana considered the application of the FAO guidelines of land evaluation for rainfed agriculture. De (1989) studied the importance of site assessment sub system in land use planning and suggestions were made for research methodologies to improve the final grading system of LESA (Land Evaluation and Site Assessment) to reflect the local needs and objectives more adequately while responding to the national interest.

According to Dent and Young (1981) there are three types of land evaluation namely qualitative, quantitative physical and economic. A qualitative evaluation is one in which the suitability of land for alternative purposes is expressed in qualitative terms only such as highly, moderately, marginally suitable or not suitable for a specified purpose. Here economic considerations are present in the background. It permits the integration of many aspects of benefits, social, environment and economic considerations. This can be used in both developed and developing countries. The results of the evaluation remain valid for many years. The next one namely 'quantitative physical evaluation' is one which provides quatitative estimates of the production or other benefits such as crop yields, rates of timber growth etc. To do this it is necessary to specify the inputs also in quantitative terms eg: tonnes of fertilizer, man-days of labour, quantity of pesticides etc. Here also economics is in the background. Only some approximate calculations of costs and prices are made and it forms the basis for economic evaluation. The third one 'economic evaluation' is one which includes results given in terms of profit and loss for each specified enterprise on each kind of land. Here the boundary between highly suitable, moderately suitable etc. are defined in economic terms. This type of evaluation is always required for project appraisal. Economic evaluations are ephemeral in nature, changing with fluctuation in costs and prices. However the fundamental purpose of a land evaluation is to predict the consequences of change.

Land capability, land irrigability and land suitability are the three important aspects that need consideration in the process of land evaluation for a sustainable agricultural system. According to Dent and Young (1981), the 'land capability classification was originally devised by Klingebiel and Montgomery in 1961 for farm planning in the USA. This enables the land on a farm to be allocated rationally to different land uses. In this system the land is put into eight capability classes ranging from Class I (best) to Class VIII (worst). 'Land irrigability classification helps in deciding the land levelling works needed, reclamation works needed, alignment of canals, lining of canals etc. As reported by Dent and Young (1981) the land irrigability classes range from Class 1 (highly suitable for irrigation) to Class 6 (uneconomical for irrigation). The Kerala State Land Use Board and the National Remote Sensing Agency (1994) used land capability and land irrigability for land evaluation in a study for Attapady block, Kerala State. Kerala State Soil Survey Organisation (1997) used land capability and land irrigability for land evaluation studies of Athiyannur panchayat of Thiruvananthapuram district and Kodur panchayat of Malappuram district.

Land suitability evaluation is the process of accessing the suitability of land for specific use. These may be types of agriculture, crop types, forestry types etc. Here the short comings in land capability classification are overcome and procedures are devised for comparing the suitabilities of land for different uses. Haantjens (1965) reported the use of a land suitability system in New Guinea for rating annual crops, tree crops, improved pastures and swamp rice production. The initiative for developing some measure of standardisation of this terminology and procedures was taken up by the FAO through a series of international deliberations, since 1970 and the results are incorporated in 'A frame work of land evaluation' of the FAO (1976). This include the evaluation procedures for specific crops and land utilization types.

2.1.1 Participatory land evaluation

The UNO (1979) referred participation as sharing by people the benefits of development, active contribution by people to development and involvement of people in decision making at all levels of the society. In the view of Oakley (1987), participation explained the efforts to encourage rural people to collaborate with programmes already devised which cover activities of community development type in which community involvement is a means of ensuring the survival of a project. It can be applied as initiatives to facilitate the formation of people's organization at local level which will help the poor people to gain a voice in decision making and empower them both economically and politically. Participation is generally recognized as a process and not some kind of static and product of development. The UNDP (1993) referred participation as the close involvement of the people in economic, social, cultural and political process that affect their lives. People may in some cases have complete and direct control over the processes. In other cases control may be partial or indirect. However the important thing is that people have constant access to decision making and power.

Mishra (1994) opined that participation has three connotations. It means co-operation, taking part in something or mere presence. It can be direct or indirect, passive or active and it is the important technique to achieve a desired goal. According to Chowdhry and Gilbert (1996) participation is a generic term covering wide range of activities from one-shot problem identification such as PRA to continuing association in which rural communities and individual farm families play more active role.

Bava (1997) expressed that participation helps to achieve citizens involvement in the various interfaces of development such as decision making process, planning, implementation and evaluation of plans and policies. According to Parker (1997) participation ranges from local people being involved in implementing development or conservation of programmes to be actively involved in all stages of the development process including decision making. In the words of Ray (1997), participation is a process of getting one self involved in thoughts, feelings and actions with others. It can be perceived as a continuum varying between passive listening to active involvement in benefit sharing. Kareem and Jayaramaiah (1998) opined participation as the degree to which the members of the beneficiary families involve themselves in different stages of the programme, starting from the selection of beneficiaries to deriving benefits from assistance provided under the programme.

Human settlements in rural areas tend to develop proximate relationship with the local land and with the locally available land resources. Members of these settlements acquire first hand knowledge about the status of these resources namely their availability, utility, characteristics, problems, potentials etc. This store house of knowledge at local level is a powerful data bank for the sustainable management of these resource in the event of implementation of various development programmes. This vision paved way to the development of the concept of Participatory Appraisal of Natural Resources by Mukherjee (1997). Participatory Appraisal of Natural Resources (PANR) is a way of learning from local community about natural resources and related issues. This is based on PRA principles which enable the local people to participate in knowledge building exercises, investigate and analyse their problems, evaluate constraints, opportunities and take optimum decisions regarding natural resource management. Pande *et al.* (2002) through their study revealed that user-community specific factors (contact with agency, frequency of benefits drawn) by and large determined peoples participation in afforestation programmes. Also resource specific factors played significant role in determining the participation of a group.

2.1.1.1 Participatory approach for sustainable agriculture

The successful implementation of any agriculture development programmes for sustainable agriculture needs proper land evaluation, decision making and implementation through participatory approach. Whyte (1991) opined that till early ninetees it was the responsibility of professionals to determine what worked best for the farmers (small or large) and then efforts were made to persuade the farmers to accept the ideas of professionals ie., a 'top-down' model. This had no scope of utilizing the information or ideas gathered by small farmers in helping them to be better. The dominance of this model led to the development of HYV of basic grains. Several years of experience indicated that this benefit was secured by only large farmers with irrigated fields and small farmers who had access to irrigation. This constituted only a minor sector of the global farming community.

Many studies were conducted to assess the scope of participatory approach in the field of agricultural development. Turton and Reddy (1998) opined participatory approach helped in improving productivity and sustainability. Varma and Chauhan (1998) in a study on development of waterlogged eco-system under NWDPRA found that the success of the strategies, replicability and sustainability of the technologies adopted depends on effective involvement of the watershed community from planning to implementation stage. Nyonand *et al.* (1999) used PRA in evaluating the resource in Ratanpur watershed of Ganga basin. Here resource maps were prepared by transect walk, matrix ranking and personal interviews. Gichuki and Liniger (2000) opined that participatory approach of natural resources management decision support information system is in its infancy. According to him preliminary indications are that it has the potential to increase the utility of both farmer's as well as researcher's findings. Surendran (2000) found that participatory group approach occupied a key position among various developmental approaches implemented in Kerala state aiming at sustainable agriculture development.

According to Kumar and Narwade (2001), the participation level of farmers varied according to their natural resource base and priorities.

Appropriate need-based and time specific strategic intervention at various stages helped in greater involvement of the farmers. Negi (2001) in his study on participatory watershed development found that the local population was actively involved in the assessment of natural resources, identification and ranking of problems, planning, implementation, monitoring and evaluation. Patel and Rajput (2001) used PRA in watershed management. The outcome of PRA were discussed with the beneficiaries through transect walk, agro-ecological map, social map and resource map. Evaluation of the land resources revealed that water scarcity was the major problem in the area.

Anandkumar and Nandini (2002) stated that the recent approach of participatory learning, participatory experimentation and participatory extension is effective in achieving development, specifically in agriculture and rural development. They also opined that there was need for professionals, students, policy makers and general public to understand the perspectives, prospects and precautions related to the approach. Ghosh (2002) opined Indigenous knowledge (IK) is an important value input in planning and decision making related to sustainable management of natural resources. The importance of IK for the purpose of sustainable development is well recognized today. Kar *et al.* (2002) opined that PRA is one of the effective tools to get first hand information about the needs, available natural resources, problems and prospects of the farming community to adopt better agricultural management practices. In their study area they found that inspite of favourable climate, residual soil moisture after kharif rice and availability of labour and inputs, the study area was monocropped with low and unsustainable yields. The reason was that the farmers lacked knowledge regarding improved cultivation and crop substitution. Singh (2002) opined that active participation of farmers throughout is a must for generation of useful and relevant information in agro-ecosystem analysis.

The above experience revealed that participatory approach has vital role in bringing about a sustainable agricultural system. This can be achieved by learning more about the agricultural practices, cropping systems etc. of particularly the small farmers in rainfed regions and then resorting to the notion that perhaps these farmers had learned things by operating under disadvantageous condition that might even be useful for agricultural professionals. Globally the spread of participatory approach was very rapid during the last two decades. To indicate this, ODI, London has published three hundred and forty abstracts by June 1989 on 'Farmers Participatory Research' which was only thirteen prior to 1980.

2.1.2 Integrated land evaluation

The approach towards land evaluation besides productivity enhancement have other dimensions such as employment generation, innovativeness, people's participation, sustainability etc. Achievement of sustainability through agricultural development programme is very complex as it involves lot of human intervention besides the interaction of number of other physical, environment, economic and social factors. Land evaluation and its interpretative classification will reveal the best use of each piece of land. Land evaluation helps in analysing the various factors for deriving an optimum land use plan for an area.

As per the FAO guidelines (1983), the promising combination derived on the basis of biophysical factors can be subjected to analysis in terms of economic and social factors to confirm or modify their suitability in social and economic terms. This can be carried out at two levels ie., (1) qualitative analysis, where the effects of land use changes are considered with respect to a range of factors such as markets, labour, transport, population and social acceptability (2) quantitative economic analysis, where detailed economic analysis forms major component of the evaluation. Shao (1984) devised a land classification system on the basis of physical factors such as water, soil properties and current land use. This system consisted of five classes. This system was then used together with the social and economic factors to arrive at proper land evaluation. Wright (1984) devised a system of agricultural Land Evaluation and Site Assessment (LESA). This system does the evaluation of soil quality for crop production at the first instance and then assess the sites for their economic and social viability. Rossiter (1990) devised the Automated Land Evaluation System (ALES). This was a micro computer programme which allowed land evaluators to build their own knowledge base system with which they can compute the physical and economic suitability of the land units.

Samanta (1991) opined that development of a more sustainable agriculture system has become a high priority today for many nations of the world. According to him this can be achieved only through an 'integrated approach'. For the purpose, an understanding of the present farming and land use system and its development over time is necessary. This has to be combined with the limitations, possibilities of natural eco-system as well as the agricultural knowledge and experience of farming communities. The understanding of the present situation must be through assessment of the potentials of agricultural development, assessment of the available physical, biological and human resources besides political, social, cultural and economic context of the agricultural system. He also stated that the ecological farming practices for sustainable agriculture development are site specific and cannot be simply copied into any environment. Verheye (1991) reported that in the approach of integrated land evaluation besides physical resources, human and capital factors also needed consideration.

Johnson *et al.* (1994) in the study on integrated land evaluation for land use planning for Northern Australia included both biophysical and economic factors affecting land use. Smyth and Dumanski (1995) derived a Frame work of Evaluation of Sustainable Land Management (FESLM). According to them an assessment of sustainability can be achieved by comparing the performance of a given land use with the objective of five pillars of sustainable land management namely productivity, security, protection, viability and acceptability. Jayasree and Prasad (1994) identified six important dimensions of sustainable agriculture namely resource use efficiency, environmental soundness, technological appropriateness, economic viability, economic feasibility and local adaptability. Johnson and Cramb (1996) introduced the integrated method of land evaluation that generates biophysical and economic measures of land performance using crop yield prediction, expert system and risk analysis.

Krishna *et al.* (2000) in their study considered factors such as physiography, irrigation, slope, soil depth, surface texture, ground water potential, production system, population density, literacy per cent and infrastructure status as factors of ecological-economic zoning for land use planning. Verheye (2000) opined that numerical (parametric) land evaluation techniques based on physical parameters provided an excellent tool to define objectively the production potential of agricultural lands and obviously its sale value as an alternative to economic approach of land evaluation.

Summarising the views expressed by the various authors, it is felt that to achieve sustainability in agriculture development, land evaluation through 'participatory and integrated approach' is a good option to be considered for deciding the best use of each and every piece of land. Hence an attempt was made in the present study to derive a procedure for location specific crop suitability recommendation at micro watershed level under Kerala situation through participatory and integrated approach of land evaluation.

2.2 AWARENESS OF AGRICULTURAL OFFICERS ON LAND EVALUATION FOR SUSTAINABLE AGRICULTURE DEVELOPMENT

According to the Dictionary of Behavioural Science, awareness is 'being conscious of something as a state of perceiving and taking account of some event, occasion, experience or object'.

Lionberger (1960) defined awareness as the first knowledge about a new idea, product or practice. At the awareness stage an individual has only general awareness about it. Successful implementation of any development programme or a new technology needed the support of its stake holders. For the purpose, the prime step is to make the stake holders aware of the programme or the technology, its objectives, principles, aims etc. Awareness is the first step for the acceptance of a programme or a technology.

Behera and Sahoo (1975) in a study on the impact of National Demonstration for adoption of agricultural practices, revealed that three fourth of the sample farmers were aware about the National Demonstration some way or the other.

Babu (1980) found that 3/4th of the participants and 1/2 of the non-participants had medium level of awareness about Integrated Dry land Agricultural Development Programme.

According to Haraprasad (1982), the beneficiaries of Small Farmers Development Agency of Trivandrum district, Kerala State had high level of awareness on its activities.

Reddy (1984) in his study found that the awareness about NARP functions were brought in among farmers through personal visit, training programme, field visit etc.

Sajeevchandran (1989) through a study in Kerala found that there was significant difference in the awareness level among the beneficiaries and non-beneficiaries about the pepper development programme.

Ganesan and Muthaiah (1991) through their study revealed that there was significant differences among officials, leaders and farmers of Madurai district of Tamil Nadu with respect to their awareness level about the different agricultural development schemes.

Karim and Mahboob (1992) found that the performance of Subject Matter Officers of Department of Agriculture, Bangladesh increased significantly with more technical information and awareness on the problems in agriculture.

Kumar and Dhawan (1992) reported that majority of the farmers of Kandy area of Punjab were having high level of awareness about the land development programmes being implemented in the area.

Sureshkumar and Venkataramaiah (1992), in their study on the awareness of beneficiaries of Jawahar Rozgar Yojana, reported that those persons who were benefited by the programmes had very high awareness level about the programme when compared to the non-benefited persons.

Jnanadevan (1993) reported that majority of the farmers of Coconut Development Programme had higher level of awareness about the programme.

Pushpa and Seetharaman (1998) found that the awareness of TRYSEM beneficiaries about the programme in general and about the different schemes of TRYSEM was at medium level. Hence they suggested that appropriate dissemination strategies have to be evolved.

Ashaletha (2000) in her study found that awareness about National Agricultural Research Project (NARP) among the rice farmers of Southern Agro-climatic zone of Kerala was very low. Only thirty per cent of the farmers were aware of the programme.

The above studies revealed the importance of awareness level of the stakeholders about a programme or technology. The awareness towards a programme or technology is important for its acceptance. In this study also awareness formed an important variable. Hence an attempt was made to study the awareness level of Agricultural Officers towards land evaluation for sustainable agriculture development, as Agricultural Officers formed one of the key users of this technique.

2.3 KNOWLEDGE OF AGRICULTURAL OFFICERS ON LAND EVALUATION FOR SUSTAINABLE AGRICULTURE DEVELOPMENT

Oxford English Dictionary defined knowledge as acquaintance with a branch of learning, a language or the life, theoretical or practical understanding of an art, science, industry etc.

Webster's New International Dictionary defined knowledge as familiarity gained by actual experience, practical skill and technical acquaintance. Pandey and Sharma (1990) defined knowledge as familiarity gained by mental experience, practical skill and acquaintance or intellectual experiences with truth or merely acquaintance with facts. Hence knowledge is generally used as synonym to acquaintance, familiarity, fact or simply to know. In scientific terms, knowledge means the totality of facts gained by human beings from experiences, experiments, fictions, mythological or artificial means through the use of mental and spiritual powers.

Williams (1958) and Rogers and Havens (1961) opined that knowledge played important role in adoption and decision making behaviour of human beings.

Sawer (1973) in a study found that the opportunities for women to participate in farm management was influenced by their knowledge and experience in farming.

Malhotra *et al.* (1974) concluded that technical knowledge significantly influenced the adoption of agricultural innovations.

Singh and Singh (1974) found that knowledge on package of practices significantly contributed to the adoption behaviour of farmers.

Samad (1979) found that in coconut package and pepper package programme areas of Kerala, the knowledge of farmers about improved cultivation practices were more when compared to the non-package areas.

Jaiswal and Purandare (1982) reported that the sectoral officers lacked basic knowledge on watershed concept and its operation at field level, resulting in non-integration of activities.

Singh and Singh (1983) through their study revealed that lack of knowledge about the utility of soil conservation practices was the main constraint in its adoption by the beneficiaries.

Waghmare *et al.* (1988) in their study observed that 19.33 per cent of the fruit and vegetable growers fell in low knowledge category, 60 per cent in medium category and 1/5th of the respondents possessed adequate knowledge about horticultural development programmes.

Bonny (1991) revealed that majority of vegetable growers had medium level of knowledge on improved vegetable cultivation. Similarly, Gangadharan (1993) also found that majority of pepper growers had medium level of knowledge about improved agricultural practices.

According to Jnanadevan (1993) majority of beneficiaries of coconut development programme possessed high level of knowledge about the programme. Reddy and Iqbal (1993) in their study found that the knowledge level of majority of beneficiaries was high while that of majority of non-beneficiaries was low with respect to watershed development programme.

Manjunath *et al.* (1996) revealed that majority (53 per cent) of farmers belonged to medium knowledge category, twenty four per cent and twenty three per cent belonged to high and low categories respectively with respect to their knowledge on dry land farming practices.

Ashaletha (2000), in her study, found that majority of rice farmers (70 per cent) had higher knowledge level on improved practices. In another study, Manoj (2000) found majority of rice cultivators ie., 54.29

per cent were in low knowledge group regarding the recommended practices.

The above studies revealed that the knowledge level of stakeholders on an information or technology varied under different situation. It is a fact that proper knowledge of the stakeholders on an information or technology is an indication on its effective transfer. Hence in this study also an attempt has been made to assess the knowledge level of Agricultural Officers on land evaluation who is the key stakeholder of land evaluation for sustainable agriculture.

2.4 ATTITUDE OF AGRICULTURAL OFFICERS TOWARDS LAND EVALUATION FOR CROP SUITABILITY

The concept of attitude is probably the most indispensable concept in behavioural science. The influence of attitude upon psychological processes such as learning, remembering, perception, reasoning, decision making, adoption etc. has been studied by many social scientists. Allport (1935) expressed attitude as mental and neutral state of readiness organised through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related.

Thurstone (1946) defined attitude as the degree of positive or negative affect associated with some psychological object towards which people can differ in varying degrees.

Krech and Crutchfield (1948) defined attitude as an enduring organisation of motivational, emotional, perceptual and cognitive process with respect to some aspects of individual world.

Katz and Scotland (1959) stated that attitude is a tendency or disposition to evaluate an object or the symbol of that object in a certain way.

Rai (1965) revealed that adopters of new ideas had favourable attitude towards government programmes.

Majumdar and Majumdar (1967), in their study, concluded that attitude was significantly related with adoption behaviour of farmers.

Clifford and Richard (1971) defined attitude as a learned orientation or disposition towards an object or situation which provides a tendency to respond favourably or unfavourably to an object or situation.

Sharma (1972) expressed attitude as a personal disposition which impels an individual to react to some object or situation.

Dahama (1976) opined that attitudes are learned responses and since they are always found in relation to object, ideas and persons, they play an important role in determining human behaviour.

According to Blair (1978) attitude is predisposition to respond to certain set of facts.

Kuppuswamy (1984) stated that attitude are learned in the course of life experience, which make the individual behave in characteristic way towards persons, objects or issues to which they get related. Prajapathi and Patel (1984) in their study found that 15 per cent of the extension workers had unfavourable attitude towards T&V programme, 22.5 per cent had favourable attitude and majority (62.5 per cent) had neutral attitude.

In a study Sheela (1989) found that in Kerala only 33 per cent of Junior Soil Conservation Officers and 32 per cent of Junior Soil Survey Officers had favourable attitude towards watershed planning. According to her majority of Agricultural Officers had unfavourable attitude.

Judd *et al.* (1991) expressed attitude as evaluation of various objects that are stored in the memory.

Fathimabi (1993) in her study concluded that most of the agricultural labourers had favourable attitude towards the welfare schemes for agricultural labourers implemented by Government of Kerala. Gangadharan (1993) in another study on pepper growers of Kerala found that majority (89 per cent) of the pepper growers had favourable attitude towards improved agricultural practices.

Sindhudevi (1994) found that majority of neo-literate farmers (90.7 per cent) had a favourable attitude towards scientific agricultural practices.

Hemelatha (1997) revealed that more than 55 per cent of the paddy farmers in Thiruvananthapuram district had favourable attitude towards rice based farming system. In a study among scheduled caste farm families of Kerala, Rajendralal (1997) opined that for any development programme to achieve maximum people's participation, the beneficiaries must have a positive attitude towards the developmental programme.

Beena (2002) opined that favourable attitude towards gramasabhas helped planners in devising suitable strategies for the better functioning of the gramasabhas.

The views of the above authors revealed that the attitude of human beings towards an object, programme etc. varied with situation. It can be concluded from the above studies that favourable attitude towards a development programme, technology or innovation is a prime requirement for its increased participation and success. Hence in this study also attitude towards land evaluation for crop suitability by Agricultural Officers was considered to be important as Agricultural Officers are one of the prime stakeholders of land evaluation for sustainable agriculture development.

2.5 RELATIONSHIP OF SELECTED PROFILE CHARACTERISTICS OF AGRICULTURAL OFFICERS WITH RESPECT TO THEIR AWARENESS, KNOWLEDGE AND ATTITUDE TOWARDS LAND EVALUATION FOR SUSTAINABLE AGRICULTURE

Number of studies were conducted on the nature of relationship existing among the socio-economic characteristics of extension personnel, farmers, scientists etc. and their awareness, knowledge and attitude towards agriculture development programmes, improved practices, new technologies etc. These studies revealed different kinds of relationship. The present study deals with the relationship of selected profile characteristics or variables of Agricultural Officers which directly or indirectly influence their awareness, knowledge and attitude towards land evaluation for sustainable agriculture development.

The profile characteristics can be personal or situational as stated by Saiyadain (1980). Agricultural Officers are one of the key stakeholders for the technique of land evaluation for sustainable agricultural development. Hence, it was pertinent to analyse the profile characteristics of Agricultural Officers in this study. An attempt was made to review the related studies to give an orientation to the study for analysing the pattern of relationship of the selected seventeen profile characteristics of Agricultural Officers with their awareness, knowledge and attitude towards land evaluation for sustainable agriculture.

2.5.1 Sex

Heggade (1982) opined that women's involvement in economic decision making was a vital means by which their economic dependency and social inequality could be removed. Their involvement in decision making resulted in increasing employment opportunities for women.

Natarajan and Thenmozhy (1991) reported that women possessed entrepreneurial skill to start an enterprise.

Singh (1993) concluded that the factors impinging on entrepreneurial manifestation of women are no different from those of men.

Seema (1997) found that the male agricultural graduates had high level of attitude than female students towards self confidence, self esteem and management orientation.

2.5.2. Age

The findings of researchers showing the relationship of age with awareness, knowledge and attitude are given below.

Authors	Year	Nature of relationship
1. Relationship of age with awareness		
Cherian	1984	Negative and significant
Sekhar and Perumal	1988	Positive
Srinath	1988	No relation
Sajeevchandran	1989	Non-significant
Nelson	1992	Non-significant
2. Relationship of age with knowledge		
Gnanadeepa	1991	Positive and significant
Kumar and Reddy	1993	Negative and significant
Manju	1996	Non-significant
Hanumanikar *et al.*	1997	Negative and significant
Lenin and Veerabhadraiah	1997	Non-significant
Preetha	1997	Non-significant
Sheela and Sundaraswamy	1999	Non-significant
Manjusha	2000	Negative and significant
Thomas	2000	Significant
3. Relationship of age with attitude		
Mani	1980	Significant and negative
Perimbam	1981	Significant and positive
Vijayakumar	1983	Significant
Ranganathan	1984	Non-significant
Krishnakumar	1987	Non-significant
Prabhu	1988	Non-significant
Sajeevchandran	1989	No relation
Nelson	1992	Non-significant

2.5.3 Educational status

Results of the studies showing the relationship of educational status with awareness, knowledge and attitude are given below.

Authors	Year	Nature of relationship
1. Relationship of educational status with awareness		
Haraprasad	1982	Positive and significant
Cherian	1984	Positive and significant
Selvakumar	1988	Significant
Theodore	1988	Significant
Kunju	1989	Significant
Sumana and Reddy	1998	Significant
2. Relationship of educational status with knowledge		
Sethy *et al.*	1984	Significant
Anithakumari	1989	Significant
Babu	1995	Positive
Jayasubramaniam	1996	Positive and significant
Hanumanikar *et al*	1997	Positive and highly significant
Manju	1997	Positive and highly significant
Preetha	1997	Negatively significant
Manjusha	2000	Negatively significant
3. Relationship of educational status with attitude		
Mathew	1980	Positive and significant
Vijayakumar	1983	Significant
Ranganathan	1984	Positive relation
Krishnakumar	1987	Positive and significant
Mary *et al*	1994	Positive and significant
Lenin and Veerabhadriah	1997	Not significant

2.5.4 Rural / urban background

Saijonkar and Patel (1970) opined that rural / urban background of VLWS of Kaira district, Gujarat influenced their job effectiveness.

Reddy and Reddy (1977) found that the urban contact of farmers did not have significant relationship with the attitude of farmers towards crop loan system.

Mani and Knight (1981) in a study on attitude towards regulated market found a non-significant relationship between rural/urban background and attitude.

Siddaramaiah and Gowda (1987) reported that rural-urban background of extension guides in Karnataka had a highly significant relationship with their job performance.

Kalavathy (1989) reported the rural-urban background of Agricultural graduates working in the Department of Agriculture, Kerala had no significant relation with their performance in the job.

Lenin and Veerabhadriah (1997) found that there was non-significant relationship between the rural-urban background of extension personnel and their attitude towards broad based extension.

Rambalu (2000) opined that the the rural-urban background had a positive relation with the knowledge level of Agricultural Extension Officers.

Sawant *et al.* (2000) reported that there was a positive relationship between rural-urban background and the attitude of Higher Secondary School students towards agriculture course.

2.5.5 Training received

Results of studies highlighting the relationship of the variable 'training received' with awareness, knowledge and attitude are given below.

Authors	Year	Nature of relationship
1. Relationship of training received with awareness		
Cherian	1984	Positive and significant
Nelson	1992	Non-significant
Sumana and Reddy	1998	Non-significant
Ashaletha	2000	Non-significant
2. Relationship of training received with knowledge		
Rayappareddy & Jayaramaiah	1989	Positive and Significant
Chauhan *et al.*	1990	Positive
Prasad and Mahipal	1997	Significant
Das and Sharma	1998	Positive
Ashaletha	2000	Non-significant
Kher and Patel	2000	No relation
Parthasarathi and Govind	2002	Positive and highly significant
3. Relationship of training received with attitude		
Basha *et al.*	1975	Non-significant
Rahiman and Menon	1980	No relation
Cherian	1984	Positive and significant
Nataraju *et al*	1991	Positive
Nelson	1992	Non-significant
Lenin and Veerabhadraiah	1997	Non-significant
Das and Sharma	1998	Significant

2.5.6 Job experience

Few relevant studies showing the relationship of job experience with awareness, knowledge and attitude are given below.

Authors	Year	Nature of relationship
1. Relationship of job experience with awareness		
Mani	1980	No relation
Nandakumar	1980	Negative and significant
Balasubramani	1981	No relation
Sekar and Perumal	1988	Positive and significant
Selvakumar	1988	Non-significant
Theodore	1988	Positive and significant
Nelson	1992	Non-significant
Vijayalayam	2001	Non-significant
2. Relationship of job experience with knowledge		
Gnanadeepa	1991	Positive and significant
Philip	1995	Non-significant
Jayasubramaniam	1996	Positive and significant
Manju	1996	Non-significant
Preetha	1997	Positive and significant
Jose	1998	Negative and significant
Manjusha	2000	Negative and significant
Sreedaya	2000	Positive and significant
Vijayalayam	2001	Negative and significant
3. Relationship of job experience with attitude		
Jayavelu	1980	Negative and significant
Rahiman and Menon	1980	Significant
Ravichandran	1980	Positive and significant
Krishnakumar	1987	Non-significant
Prabhu	1988	Non-significant
Murugesan and Nanjaiyan	1996	Non-significant
Tripathi and Kunzru	2000	Positive and significant

2.5.7 Cosmopoliteness

Results of studies highlighting the relationship of cosmopoliteness with awareness, knowledge and attitude are given below.

Authors	Year	Nature of relationship
1. Relationship of cosmopoliteness with awareness		
Kamarudeen	1981	Non-significant
Nelson	1992	Non-significant
2. Relationship of cosmopoliteness with knowledge		
Gnanadeepa	1991	Negative and significant
Gangadharan	1993	Positive
Meera	1995	Non-significant
Manju	1996	Non-significant
Preetha	1997	Negative and non-significant
Jose	1998	Positive
Veeriah *et al.*	1998	Positive and significant
Manjusha	2000	Positive and significant
Sadanandan	2002	Positive and significant
3. Relationship of cosmopoliteness with attitude		
Kamarudeen	1981	Non-significant
Vijayakumar	1983	Positive and significant
Nelson	1992	Non-significant
Meera	1995	Non-significant

2.5.8 Exposure to Internet / Information technology

Studies directly related to Internet / Information technology (IT) exposure of scientists, extension personnel, farmers etc. with awareness, knowledge and attitude were lacking. Hence studies related to exposure with information sources and mass media were reviewed for the purpose of this study.

Authors	Year	Nature of relationship
1. Relationship of exposure to Internet / IT with awareness		
Sajeevchandran	1989	Positive and significant
Nelson	1992	Non-significant
Jnanadevan	1993	Positive and significant
Kunju	1989	Positive and significant
Ashaletha	2000	Significant
2. Relationship of exposure to Internet / IT with knowledge		
Cherian and Chandra	1989	Positive and significant
Gnanadeepa	1991	Negative
Juliana *et al.*	1991	Positive and significant
Manju	1996	Non-significant
Saini and Singh	1996	Positive and significant
Ashaletha	2000	Significant
Preetha	1997	Positive and significant
3. Relationship of exposure to Internet / IT with attitude		
Sushama	1979	Positive and non-significant
Prakash	1980	Positive and non-significant
Kamarudeen	1981	Positive and significant
Cherian	1984	Positive and significant
Sajeevchandran	1989	Positive and significant
Murugesan and Nanjayan	1996	Non-significant

2.5.9 Entrepreneurial behaviour

Singh (1970) found a positive relationship between attitude and entrepreneurship of entrepreneurs.

Mishra and Sinha (1981) revealed a positive relationship between the knowledge level and entrepreneurship among farm entrepreneurs.

Sethy *et al.* (1984) opined that knowledge was an important entrepreneurial character which promoted the adoption of improved agricultural technology.

De (1986) stated that entrepreneurship is an important factor that contributed significantly to the progressiveness of farmers.

Matani (1995) opined that farming entrepreneurship can bring in socio-economic salvation to Indian society.

Jayalekshmi (1996) found positive and significant relationship between the knowledge and attitude of rural women and their entrepreneurial behaviour.

Nizamudeen (1996) found that attitude towards self employment had a non-significant relationship with the entrepreneurial behaviour of Kuttimulla farmers. His study also revealed that knowledge level of farmers had a significant relationship with entrepreneurial behaviour.

2.5.10 Innovation proneness

Few relevant studies showing the relationship of innovation proneness with awareness, knowledge and attitude are given below.

Authors	Year	Nature of relationship
1. Relationship of innovation proneness with awareness		
Balasubramani	1981	Positive and significant
Sajeevchandran	1989	Positive
Nelson	1992	Positive and significant
Ashaletha	2000	Positive and significant
Vijayalayan	2001	Positive and significant
2. Relationship of innovation proneness with knowledge		
Gangadharan	1993	Positive and significant
Nirmala	1993	Positive and significant
Manju	1997	Negative and significant
Preetha	1997	Negative and non-significant
Jose	1998	Positive and significant
Manjusha	2000	Not significant
3. Relationship of innovation proneness with attitude		
Ravichandran	1980	Negative and significant
Balasubramani	1981	Negative and significant
Sajeevchandran	1989	No relation
Nelson	1992	Significant
Nagabhushanam and Nanjaiyan	1998	Significant and positive

2.5.11 Self confidence

Khare (1976) opined that self confidence would play an important role in the success of a creator or an innovator.

Sheela (1989) found that the self confidence of Junior Soil Conservation Officers of Government of Kerala was significantly and positively correlated with their knowledge level in watershed planning. Similarly, she also found that there was positive and significant correlation between self confidence and their attitude towards watershed planning.

Varma (1996) in another study found that self confidence was positively and significantly correlated with the attitude of farmers towards rice cultivation.

Nath (2002) found positive and significant correlation between self confidence and attitude of labour force towards people's plan in Kerala.

2.5.12. Scientific orientation

Findings of researchers showing the relationship of scientific orientation with awareness, knowledge and attitude are furnished below.

Authors	Year	Nature of relationship
1. Relationship of scientific orientation with awareness		
Nandakumar	1980	Positive and significant
Theodore	1988	Non-significant
Sajeevchandran	1989	Positive and significant
Nelson	1992	Positive and significant
Kavitha	2001	Positive and significant

2. Relationship of scientific orientation with knowledge		
Senthil	1983	Positive and significant
Syamala	1988	Positive and significant
Juliana *et al.*	1991	Positive and significant
Jnanadevan	1993	Positive and significant
Meera	1995	Positive and significant
Kavitha	2001	Positive and significant
3. Relationship of scientific orientation with attitude		
Subbaraj	1980	Positive and significant
Cherian	1984	No relation
Nelson	1992	Significant
Jnanadevan	1993	Positive and significant
Meera	1995	Non-significant

2.5.13 Achievement motivation

Mc Clelland (1961) explained achievement motivation as the desire to do well not so much for the sake of social recognition or prestige, but to attain an inner feeling of personal accomplishment.

Singh (1974) reported a significant and negative correlation between the level of performances of Block Development Officers and their achievement motivation.

Durand (1975) opined that people with a need to achieve do perform better.

Durand (1975), Luthans (1983), Reddy (1983), Singh and Srivastava (1983) reported significant association between achievement motivation and level of performance.

Reddy and Reddy (1988), Rayapareddy and Jayaramaiah (1989) found significant and positive relationship between the level of knowledge and achievement motivation.

Lenin and Veerabhadraiah (1997) in their study found that there was no significant relation between attitude and achievement motivation.

Nath (2002) found a positive and significant relationship between achievement motivation and attitude of labour force towards People's Plan in Kerala.

2.5.14 Attitude towards profession

Studies highlighting the relationship between attitude towards profession with awareness and knowledge are given below. Profession includes scientific agriculture also.

Authors	Year	Nature of relationship
1. Relationship of attitude towards profession with awareness		
Nandakumar	1980	Positive and significant
Kamarudeen	1980	Positive and significant
Jnanadevan	1993	Positive and significant
Ashaletha	2000	Positive and significant
Thenmathi	2001	Positive and significant

2. Relationship of attitude towards profession with knowledge		
Manivannan	1980	Positive and significant
Syamala	1988	Positive and significant
Singh *et al.*	1991	Negative and significant
Jnandevan	1993	Positive and significant
Ashaletha	2000	Positive and significant
Marimuthu	2001	Positive and significant
Sadanandan	2002	Positive and significant

2.5.15 Job satisfaction

Subalekshmi and Singh (1974) found nearly two-third of Gramasevikas were either very much satisfied or satisfied with their job, while 20 per cent were dissatisfied or very much dissatisfied and the remaining percentage were neutral.

Perumal and Rai (1979) reported that majority of Agricultural Extension Officers of Tamil Nadu were in average job satisfaction category and the rest in low or high categories.

Holder (1984) considered job satisfaction as a positive response towards the job as a whole.

Studies showing the relationship of job satisfaction with awareness, knowledge and attitude are given below.

Authors	Year	Nature of relationship
1. Relationship of job satisfaction with awareness		
Nelson	1992	Non-significant
2. Relationship of job satisfaction with knowledge		
Parshad	1981	Non-significant
Rayapareddy and Jayaramiah	1989	Positive and significant
Sheela	1989	Non-significant
3. Relationship of job satisfaction with attitude		
Karami	1981	Positive and moderate correlation
Dakhore & Bhilengaonker	1987	Positive and significant
Mohanty	1988	Positive
Kalavathy	1989	Non-significant
Sheela	1989	Non-significant
Nelson	1992	Positive and significant
Lenin & Veerabhadraiah	1997	Non-significant

2.5.16 Job involvement

According to Kanter (1968) job commitment is the willingness of members to give their energy and loyalty to the organization.

Mowday *et al.* (1974) opined that in any situation, employees with high commitment performed better than less committed employees.

Singh and Patiraj (1987) reported that job involvement does not have any effect on their performance in the job.

Few studies showing the relation of job involvement with awareness, knowledge and attitude are given below.

Authors	Year	Nature of relationship
1. Relationship of job involvement with awareness		
Nelson	1992	Non-significant
2. Relationship of job involvement with knowledge		
Rambalu	2000	Positive and significant
3. Relationship of job involvement with attitude		
Kalavathy	1989	Positive and significant
Nelson	1992	Positive and significant

2.5.17 Organizational climate

Rayappareddy and Jayaramiah (1989) in their study found positive and significant relationship between the knowledge level of Village Extension Officers on rice production technology and organizational climate.

Lenin and Veerabhadraiah (1997) reported a non-significant relationship between organizational climate and the attitude of extension personnel towards broad based extension.

2.6 DEVELOPMENT OF 'SPATIAL CROP SUITABILITY' MODEL AT MICRO WATERSHED LEVEL FOR SUSTAINABLE AGRICULTURE

Resource based land use planning is essential to give stability and sustainability to the sphere of agriculture development. It is true that technological advancements conducive to higher productivity are not necessarily always helpful to eco-sustainability. This is because land is a dynamic and complex combination of factors such as geology, geography, hydrology, soils, flora, fauna etc. which are constantly interacting under the influence of climate and biotic interferences. Sustainable agriculture development is possible only when the useful life of a resource is prolonged in order to permit its use not only by the present generation, but also by the future generations. To achieve this goal, it is necessary to ensure that the ecological balances are maintained while exploitation of these resources take place. As opined by Bora (1991), the age old cropping practices have been evolved as a result of the interaction of geo-climate and socio-economic factors which are in harmony with the nature.

Crop suitability recommendation on 'agro-ecological' and 'watershed' basis is most appropriate for sustainable agriculture development. According to Bora (1991), the existing farming systems in different agro-ecological situations need to be grouped into homogenous units to facilitate the application of tested technologies for crop production as well as improving livestock quality. In this attempt environmental suitability, social acceptability and economic viability should be taken into consideration.

Resource based planning become more realistic when it is fulfilled through the process of 'spatial planning'. This can be achieved through evaluation of the resources in terms of its problems and potentials with the help of 'spatial database'. In other words 'spatial data' is a pre-requisite for realistic land evaluation. It will help in placing each and every piece of land to its optimum use, resulting in economic, social and ecological stability. Such a result cannot be expected with the use of non-spatial data alone. While 'spatial data' is usually presented in the form of metric quality maps, 'non-spatial data' is provided only in the form of numerical information or tabular data. Hence non-spatial data alone does not yield information on the exact location and magnitude of the problems and potential of the resources for location specific planning.

2.6.1 Watershed approach

Etymologically the word 'Watershed' has its root in the German word 'Wassersheide'. 'Wasser' means water and 'sheide' means shedding. Watershed is a drainage area with well defined natural boundaries. According to Jaiswal *et al.* (1985) watershed is the most scientific unit for efficient management of land and water resources as it is basically an agro-climatic unit. A watershed can be considered as a hydro-geological and bio-physical entity. It behaves as an independent system in all ecological aspects. Each watershed has its own carrying capacity within which it limits its function. Singh *et al.* (1994) defined watershed or a drainage basin as a natural unit draining run off water to a common point. It can be demarcated based on ridge and gully lines. Yadav and Bhushan (2001) defined watershed as a hydrologic and geomorphologic area of land that drains to a particular outlet. Since water follows a definite course, watershed becomes an ideal hydrological unit for developmental activities. Sivanappan (2002) expressed watershed as an area from which runoff, resulting from precipitation flows past a single point into a large stream, river, lake or an ocean.

The developmental efforts on watershed basis undertaken by developed countries like USA, Germany etc. had revealed that this philosophy has scope for replication in varied situations prevailing in less developed nations also. Hence watershed as a globally accepted unit is ideal for ensuring inter ecological linkages and it provides for integration and sustainable use of the basic resources namely land and water. It integrates the biophysical, social and economic inputs for optimum results from the developmental efforts undertaken. The views expressed by the following authors substantiate the advantage of watershed management for sustainable agriculture development.

Dhandar and Subramanian (1991) opined that watershed management helps in soil conservation and enrichment and better moisture retention, resulting in higher yield and lasting production. Verheye (1993) stated that with reference to Indian conditions, planning at micro watershed level had many advantages for land use planning and resource management. Bhardwaj and Dhyani (1994) revealed that watershed management proved to be an effective tool for drought mitigation and flood moderation resulting in conservation of soil and water resources. Singh *et al.* (1994) opined watershed management practices must be planned to develop and exploit the optimum production potential of the resources, namely climate, land, water, plant, man and livestock, so as to produce abundance in a sustained manner without deteriorating the resource base.

In the views of Dhar (1996) adoption of integrated watershed management approach can help to bring out a dynamic and constructive balance between man and environment in hilly regions since such a management incorporate micro-planning, resource use integration and choice by local communities. Realizing the potential of resource conservation on watershed basis, Government of India (1997) made guidelines for participatory watershed management as recommended by Hanumantha Rao Committee. According to Sahra and Mishra (1997), watershed is a virtually accepted unit of management for efficient, collective and integrated management of natural resources. It is the rational utilisation of land and water resource for optimum sustained production with minimum hazards to natural resources. Hence watershed approach assumes special significance in bringing about sustainability in agriculture.

The study by Agnihotri and Samra (1998) revealed that the watershed management programmes helped in increasing crop yields, fodder yields and milk production. These programmes were found to be economically viable apart from being eco-friendly and socially acceptable. Varma and Singhal (1998) reported that the integrated watershed development in flood prone areas resulted in appreciable changes to the eco-system. Besides productivity enhancement of crops, there has been appreciable reduction in run off and silt yield. It also helped in increased ground water recharging. The study by Singh (1999) revealed that the average family income within the watershed area was 21.50 per cent higher than the outside area. Similarly the income from agricultural sector was 21.89 per cent higher within the watershed area when compared to outside area.

Bhuyan (2000) opined that watershed management projects are the answers to the frequent problem of drought. Ghosh *et al.* (2000) in a study to assess the impact of watershed treatment revealed that considerable increase in moisture and water regime was noticed in the treatment area. Ramachandran *et al.* (2001) opined that assessment of natural resources of micro watersheds is crucial for making appropriate recommendations on land utilization. He also expressed that GIS (Geographic Information System) makes the planning of watershed simpler and quicker. According to Diwate *et al.* (2002), watershed development proved to be effective in conservation of soil and water resources. They also found that more of uncultivable land can be put into cultivation as a result of watershed development activities. In the light of the above findings, watershed was considered as the development unit in the context of sustainable agriculture development in the present study also.

2.6.2 Remote sensing

Remote sensing implies sensing things which are at a distance, and detecting properties without actually coming into contact with them. Remote sensing can be defined as acquisition of information about an object which is not in intimate contact with the information gathering device. This is accomplished by measuring the reflected or emitted portion of the electromagnetic radiation (EMR). According to Curran (1985) remote sensing referred to the use of electromagnetic radiation sensors to record images of the environment which can be interpreted to yield useful information.

Efficient resource management system needs timely and reliable information or data, which can be achieved through intensive inventories of the present 'state of affairs'. The future also needs due consideration especially for those entrusted with the task of designing and implementing suitable plans for the conservation, development and management of available resources aimed at sustainable development. This calls for an appropriate 'Natural Resource Management System' for any nation. 'Natural Information System' forms a vital component of this Management System. The data gathered through the information system can be used for the effective management of natural resources. In this context 'Remote Sensing', acts as an effective tool in the generation of reliable and timely spatial information of the earth resources. However, it acts as only an effective means and not an end by itself. In the words of Varadan (1987), "the capabilities of Remote Sensing have an important and evident relevance to Concurrent Tentative Synthesis and Continuous Monitoring in relation to a Holistic Approach to Development. Remote Sensing opens up a tremendous vista of possibilities teeming with opportunities and beset with pit falls". Sahai (1988) stated that remote sensing technique can play an unique role in promoting comprehensive, reliable and up-to-date information on the character, distribution, productivity and utilisation of natural resources.

Aerial photographs and satellite images are the remote sensing data bases mainly used for extracting valuable information on natural resources. Globally the use of this technology has increased many folds during the past three decades with the launch of 'Earth Resource Satellites' for resource inventories. With the availability of high resolution and multi-temporal remote sensing data, resource inventory and analysis can be carried out with considerable speed and precision. The method of analysis of data ranges from visual interpretation to advanced computer processing. Results of the studies by following authors highlight the relevance of remote sensing technology in land evaluation and natural resource management.

Ahmadu (1988) devised a system of land evaluation for irrigation management in Bauchi State, Nigeria on the basis of FAO frame work of land evaluation. He concluded that a system approach with support of remote sensing can reduce the time of survey on land qualities. Reddy *et al.* (1990) used land evaluation for developing land use plans for land development and management. They used satellite remote sensing in combination with collateral and adequate ground truth for generating small scale land resource maps. Skole *et al.* (1994) reported that satellite remote sensing can be used for vegetation mapping in various tropical forests at different scales.

Kar (2001) opined that remote sensing is a cost and time effective technology to identify, map, inventorying and monitoring physical resources information for watershed management. Kar (2001) in another study of Yacharam watershed, Andhra Pradesh for sustainable land resource development through remote sensing and GIS, revealed the usefulness of remote sensing technology for proving up-to-date reliable and accurate information on different natural resources like existing land use / land cover, hydrogeomorphology, soil and topographical features of watershed. The study by Panda (2001) using remote sensing technique, yielded reliable information on waterlogging through visual interpretation of LANDSAT-MSS/TM database. Patel *et al.* (2001) generated spatial database (thematic maps) on soils, slope and landuse from remote sensing data, topo maps and field survey. Spatial information was integrated using GIS to prepare resource maps on composite land use and land capability.

Jayakumar *et al.* (2002), in a case study to monitor the extent of degradation of forest in Kolli hills of Eastern ghats using remote sensing and GIS obtained vital information for conservation and planning of the resources. Tomar *et al.* (2002) used integrated approach through remote sensing and GIS for generating site specific action plan for watershed management of Shipra watershed, Meghalaya. Satellite data was visually interpreted for land use, soil drainage, aspect and hydrogeomorphological information of the watershed. These information were integrated with socio-economic characteristics for generation of action plan. The action plan package consisted of plantations, silvipasture, agro-horticulture, agro-forestry, double cropping, grazing lands, aquaculture etc.

The opinions and findings of the above authors revealed the successful role of remote sensing technology for natural resource management with special reference to watershed management aimed at sustainable development. Hence in this study also remote sensing was used as one of the tools for generation of vital spatial information about the resources of the study area.

2.6.3 Spatial crop suitability model

Crop suitability evaluation is the process of assessing a land unit for a specific crop or a cropping pattern. From the earliest times, farmers have been deciding which crops are best suited for their land or as settlers where they can locate the land suited to the crops of their interest. This has often been a process of trial and error. In the era of modern planning, it has been recognized that a land cannot be simply rated from 'best' to 'worst' irrespective of the kind of use. Surveys in developing countries revealed short comings in the land capability classification. Hence procedures were devised for comparing suitabilities of land for different purposes. Example of such a system was one for use in New Guinea which provided separate suitability ratings for annual crops, tree crops, improved pastures and swamp rice production as reported by Dent and Young (1981).

The initiative for developing some measures of standardisation of the terminology of land suitability and its procedures was taken up by the FAO through a series of discussions from 1970 onwards and the results were incorporated in 'A Framework for Land evaluation' of 1976 and in the 'Guidelines : land evaluation for rainfed agriculture' of 1983. The end result of such type of land evaluation helps in generating 'suitability maps' otherwise termed as 'spatial suitability data' showing the suitabilities of each land mapping unit for specific kind of use or specific type of crop. These maps show whether a particular mapped area of land is highly suitable or moderately suitable or not suitable for a particular land use, cropping pattern or a particular crop. As opined by Dent and Young (1981), such data can be presented either as a single map with a tabular legend or as a series of individual suitability maps.

Attempts have been made by many scientists and researchers for deriving appropriate land use or crop suitability recommendations under different situations. Storie (1933) evolved a system of classification of soils for land evaluation on the basis of productivity index. 'Storie Index' expressed numerically the relative degree of suitability or value of soils for general intensive agricultural land use on the basis of soil characteristics such as depth, texture, slope and drainage.

Sys (1985) had standardised the crop requirement parameters with respect to climate and soils for important tropical and sub-tropical crops. According to him this can be considered as a guideline and it has to be reviewed to suit local conditions and sometimes to varieties of crops.

Calvo *et al.* (1987) attempted in preparing land use suitability maps for the mountainous region of Golicia, North West Spain considering the physiography, climate and soil characteristics of the region. Rhebergen (1987) used the FAO frame work of land evaluation for preparing small scale (1:250,000) land suitability maps for Botswana. Verheye (1987) conducted land suitability evaluation in major agro-ecological zones of European community for land use planning and nature protection. The system provided a basis of assessing the non-agricultural use and environmental protection.

Dhandar and Subramanian (1991) suggested 'crop suitability models' for the west coast ecosystem of India to enhance the production and productivity. The models suggested were rice based cropping system, coconut based cropping system, arecanut based cropping system, mixed farming and integrated farming system with fish culture, livestock, poultry, rice and coconut.

Baars (1996) conducted land evaluation studies in grazing lands to determine the potential carrying capacity of the grazing lands of Western province of Zambia. He prepared a vegetative map on the basis of the study. Kerala State Planning Board (1999) as part of the decentralised planning processes in Kerala envisaged a holistic resource based, spatial planning approach through the programme of preparing micro watershed based master plan at Block level. It was expected that this will enable participatory assessment of ecological, economic and social characteristics of micro watersheds of the State and also aid in the preparation of perspective spatial action plans for sustainable development of the State.

Naidu and Hunsigi (2001) in a study on land suitability evaluation to assess the suitability of Karnataka soils for sugarcane crop, used FAO frame work for land evaluation of 1976 as well as the Soil Potential Rating (SPR) method developed by Mc Cormack during 1974. Study found that the SPR method based on yield criteria was a more realistic assessment approach than FAO method of climate and soil site criteria for crop suitability. Mandal *et al.* (2002) mapped at 1:50,000 scale the cotton growing soils of Nagpur district according to suitability classes based on modified Riquier's criteria developed from farmers yield. The study revealed that 57.5 per cent of area is highly suitable, 28.5 per cent moderately suitable, 5 per cent marginally suitable and 9 per cent unsuitable for cotton crop. Natarajan *et al.* (2003) generated small scale crop suitability map for Salem district of Tamil Nadu on the basis of land capability and land irrigability information.

The above studies highlight, the relevance of 'spatial data base' or 'thematic maps' for resource based planning. This will help in generating location specific crop recommendations aimed at sustainable agriculture development in a state like Kerala with high cropping intensity and high pressure on land.

2.7 PERCEPTION OF FARMERS ON THE LIKELY UTILITY OF THE SPATIAL CROP SUITABILITY MODEL FOR SUSTAINABLE AGRICULTURE

Crow and Crow (1956) defined perception as the meaningful sensation that assumes an important role in the life of an individual. It refers to how an individual receives, interprets and respond to the stimuli picked by one's sense organs.

Kuppuswamy (1964) expressed perception as the process of becoming aware of objects or events or characteristics by means of sensory operations. According to him, the past experience of an individual influences his present perception. A person tends to identify a given object or situation in terms of what is familiar to him. Perception depends not only on the pattern of stimuli but also on the individual's past experiences and his needs.

Jaiswal and Roy (1968) opined that a farmer discards an information if it is not perceived by him as relevant to his own farming situation, his resource and goals. This perception will depend on his values, beliefs and attitudes.

According to Mitchel (1978) perception is the factor that shapes and produces what we actually experience.

Balu (1980) found that 75 per cent of participants of Intensive Agriculture Development Programme (IADP) perceived that the method of availing benefits under the scheme was highly complicated.

Taylor *et al.* (1980) expressed perception as the mental process of recognizing the stimuli we receive. So one has to perceive (recognize) and interpret a stimuli before it become a perceived message.

Muthukrishnan (1981) found that majority of users of biogas plant had better perception towards the attributes of biogas plants.

Sudha (1987) in a study on Lab to Land programme found that about 55 per cent of non-tribals and 75 per cent of the tribals belonged to the high perception group.

Venugopal and Perumal (1992) reported that as perceived by extension personnel, certain technologies developed in research stations were profitable, but it lacked practicability. Hence there is a need for proper understanding between researcher and extension personnel.

Pushpa *et al.* (1993) reported a satisfactory level of linkage in respect of research, extension and client system as perceived by all the three sub-systems.

According to Bhatia and Rajendran (1996), perception becomes complete, more accurate and more serviceable with the increase in ones experience. In the views of Pridhvi (1996), the clients involved in planning process perceive the idea of the programme in a better way.

Elangovan and Vasanthakumar (1997) in a study on the analysis of perception of extension official on eco-friendly technologies revealed that from the extension officials point of view, most of the eco-friendly practices listed in the study were found to be useful. Padmaiah and Ansari (1997) found that 58 per cent of the respondents of the watershed area perceived the watershed development programme as useful as against 56 per cent in non-watershed area.

Santhoshkumar (1999) in his study found 63.12 per cent of farmers perceived agricultural development programmes implemented through people's plan as useful to them and 36.88 per cent perceived it as least or not useful to them.

Ashaletha (2000) in her study to measure the perception of farmers about farm trials found that the perception level was above mean, indicating that the rice farmers were having favourable opinion about farm trials. In another study Parvathy (2000) found 77.5 per cent of rural women and 82.5 per cent of women office bearers had medium level of perception about people's plan.

Beena (2002) found significant difference between officials and people's representatives regarding the perception about the functioning of Gramasabhas. People's representatives had better perception than the officials. Charjan and Hajare (2002) perceived that development and dissemination of environment friendly farm technologies through appropriate scientific research and public policy support can alone lead to lasting improvement in the living and working conditions of the poor.

The study by Devi (2003) revealed that 75 per cent of the respondents perceived that micro credit made farming profitable.

In the light of the above explanations and findings, perception can be considered as an important mental process in accepting or rejecting a stimuli. The success of acceptance of an innovation or a technology depends on how well it is perceived by its stakeholders. Hence in this study also perception on the likely utility of the spatial crop suitability model by the farmers of the watershed area who are the actual beneficiaries was considered important. Without this, any effort taken to implement the crop suitability model will not achieve the desired goal.

METHODOLOGY

3. METHODOLOGY

This chapter explains the typology and description of the methods and procedures adopted for the study. It is presented under the following major headings.

3.1 Locale of the study

3.2 Selection of factors related to participatory and integrated land evaluation for crop suitability aimed at sustainable agriculture development.

3.3 Selection of respondents

3.4 Selection of variables for the study

3.5 Operationalisation and measurement of the dependent variables

3.6 Operationalisation and measurement of the independent variables

3.7 Development of spatial crop suitability model at micro watershed level through participatory and integrated land evaluation for sustainable agriculture development

3.8 Perception of farmers on the likely utility of the spatial crop suitability model for sustainable agriculture

3.9 Procedures employed in data collection

3.10 Statistical tools used in the study

3.1 LOCALE OF THE STUDY

The limitations of time, infrastructure, finance etc. forced the researcher to limit the study area within Thiruvananthapuram district of Kerala State. As per the NARP classification, this district is in the 'Southern Agro-climatic Zone'. Similarly it falls in the 'Agro-ecological' region numbers 20 and 21 of the national classification.

The present study in addition to identifying the most important bio-physical and socio-economic factors for land evaluation also envisaged mainly two other aspects - (a) assessing the extent of awareness, knowledge and attitude of Agricultural Officers towards land evaluation for sustainable agriculture development and also its relationship with the selected profile characteristics of the respondents (b) to develop a 'spatial crop suitability' model in a selected watershed area and to assess its likely utility for sustainable agriculture development as perceived by the farmers.

Thiruvananthapuram district was selected as locale for first one and a watershed area within the Neyyar river basin of Thiruvananthapuram district for the second one.

3.1.1 Description of the study locations

3.1.1.1 Thiruvananthapuram district

The name Thiruvananthapuram means abode of the sacred Snake-God 'Ananthan' on whom 'Vishnu' the God of Preservation is believed to be reclaiming. This is the southern most district of Kerala State, located between North latitudes 8^{o} 17'27" and 8^{o} 51'41" and East longitudes 76° 40'25" and 77° 17'06". The district stretches along the shores of Lakshadweep sea as its western border. It is bounded by Kollam district in the North, Thirunelveli and Kanyakumari districts of Tamil Nadu in the east and south respectively. Presently it has 113 villages, 12 block panchayats and 78 grama panchayats within the four taluks namely Neyyattinkara, Thiruvananthapuram, Nedumangad and Chirayinkeezhu. The total geographical area is 2192 sq.km. The location map is given as Fig. 1.

3.1.1.1.1 Physiography and Drainage

Physiographically the district falls in the low land, mid land and high land regions. Chirayinkeezhu and Thiruvananthapuram taluks lie in the mid land and low land regions, Nedumangad taluk lies in mid land and high land regions and Neyyattinkara taluk spreads over all the three regions. The low lands are narrow stretch of area comprising of valleys, deltas, rivers, seashore and plains with predominantly coconut palms. The mid lands are located between the high lands and low lands comprising of undulating topography with small hills and valleys. The area is under intensive agriculture. The high land region comprises of mainly the mountain ranges of Western Ghats. The area is mainly under plantation crops and forests. Agastyakoodam, the southern most peak of Western Ghats located at an elevation of 1868 meters above mean sea level falls in this district.

Out of the forty four river basins of the State, four river basins namely Neyyar, Karamana, Mamom and Vamanapuram are located in the district. The Neyyar river originates from Agastya Hills at about 1860 m above MSL. It flows in a south westerly direction and empties into Lakshadweep sea. The length of the river is 56 km with a catchment area

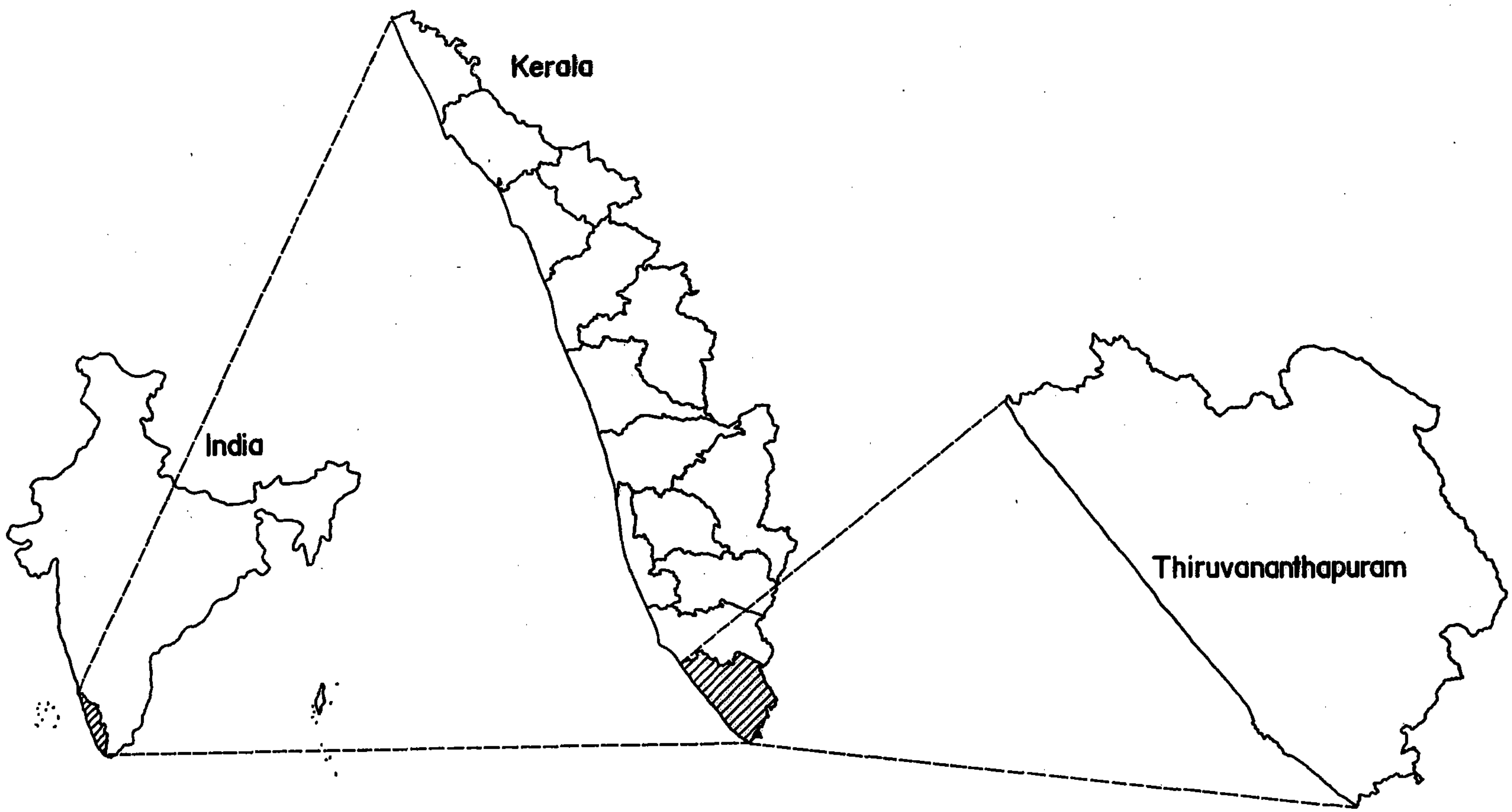

Fig:- I Location Map Of Thiruvananthapuram District of 499.99 sq.km. The Karamana river has its origin in the Chemmunji Mottai and Agastya Malai of Nedumangad hills at an elevation of 1860 m, takes a southernly flow direction till it falls into Panathura Kayal and empties into Lakshadweep Sea through Panathura inlet. The length of the river is 68 km and has a catchment area of 689.59 sq.km. The Mamom river originates from Pandalakottu Malai near Vembayam, crosses MC road at Vembayam and NH 47 at Mamom. Then it flows west and ends in Anjengo lake near Chirayinkil. The length and drainage area are 27 km and 57.11 sq.km respectively. The Vamanapuram river has its origin from Chemunji Motai at about 1860 m above MSL, flows through Kallar and has its confluence with upper Chittar. Then it flows westward through Palode where it cascades over a 13 m fall known as Meenmutti. Then again it flows westward and falls into Anjengo Lake at Chirayinkil. The length of the river is 88 km and its drainage area is 766.90 sq.km.

There are many natural lakes and chain of backwater system along with estuaries, micro-tidal inlets of permanent and temporary nature in the low land area of Thiruvananthapuram district. Vellayani fresh water lake along with the reservoirs of Neyyar, Aruvikkara and Peppara are the chief sources of good surface water. Similarly Poovar, Panathura, Akkulam, Kadinamkulam, Edava, Anjengo and Kozhithatam are part of the back water systems in the district and are brackish to saline in nature. Chackai, Chanakkara, Anjengo, Varkala and Paravur are the canal systems used for inland navigation.

3.1.1.1.2 Climate

The district enjoys a humid tropical climate. The mean annual rainfall is 2081 mm. The rainfall is distributed over South-West monsoon (June-September), North-East monsoon (October-December), Winter (January-March) and Summer (April-May) periods. Of this South-West monsoon contributes nearly 60 per cent of the rainfall.

While chilling cold climate is experienced by the mountain ranges of the district, hot climate is generally experienced by the plains. The mean annual maximum and minimum temperatures are 31.5° C and 23.4° C respectively. During the summer months of April/May the temperature rises up to 35° C and during December/January it goes down to 20° C. Generally the humidity is high and it rises upto 90 per cent during the period of south west monsoon.

3.1.1.1.3 Hydrogeology

It is estimated that out of the total geographical area of 2192 Sq.km, more than 80 per cent is underlined by crystalline rocks. Major rock types are Khondolites and Charnockites. The remaining area of about 20 per cent is covered by sedimentary rocks. The major alluvium formation in the district are laterite, warkali and recent alluvium. The area along the lineaments has good ground water prospects. The quality of ground water from the fractured crystalline area is generally very good. The low land regions has fairly good ground water potential. The mid land regions posses moderate to low potential and high lands with low to poor potential.

3.1.1.1.4 Agriculture and Soils

Agriculture and allied activities were found to be the primary occupation of the people, especially in the rural areas of the district. More than 42 per cent of the population depends on agriculture. The agricultural lands of the district mainly consisted of wet lands, garden lands and lands under plantation crops. Extensive stretches of wet land are being converted for other uses. This has led to many environmental and ecological problems. The land use/land cover of the district generated through remote sensing technique (IRS Satellite) is presented as Fig. 2. The extent of area under major crops are given in Table 1 below.

Table 1. Area under major crops in Thiruvananthapuram district

No.	Crops	Area (ha)
1	Paddy	6810
2	Pulses	651
3	Pepper	6376
4	Arecanut	1106
5	Vegetables	3561
6	Banana & other plantains	7611
7	Coconut	88604
8	Rubber	28296
9	Cashew	2461
10	Tapioca	25085

(Source: Farm guide 2004)

The soils of Thiruvananthapuram district are in general moderate to very deep with sandy to clayey texture. In isolation shallow soils are also noticed. The drainage of the soils also vary from excessively drained to imperfectly drained condition. Loamy to clayey soils are noticed in mid lands and high lands while sandy soils are located in the coastal tract of the district. The colour varies from yellowish brown to light grey in the case of Poovar series to reddish brown to red in the case of Neyyatinkara series. The erosion status of the soil also varies from slight erosion to very severe erosion. In general the available water holding capacity (AWC) of the soil is low to medium. The soils of the district can be mainly grouped into four land capability classes, namely

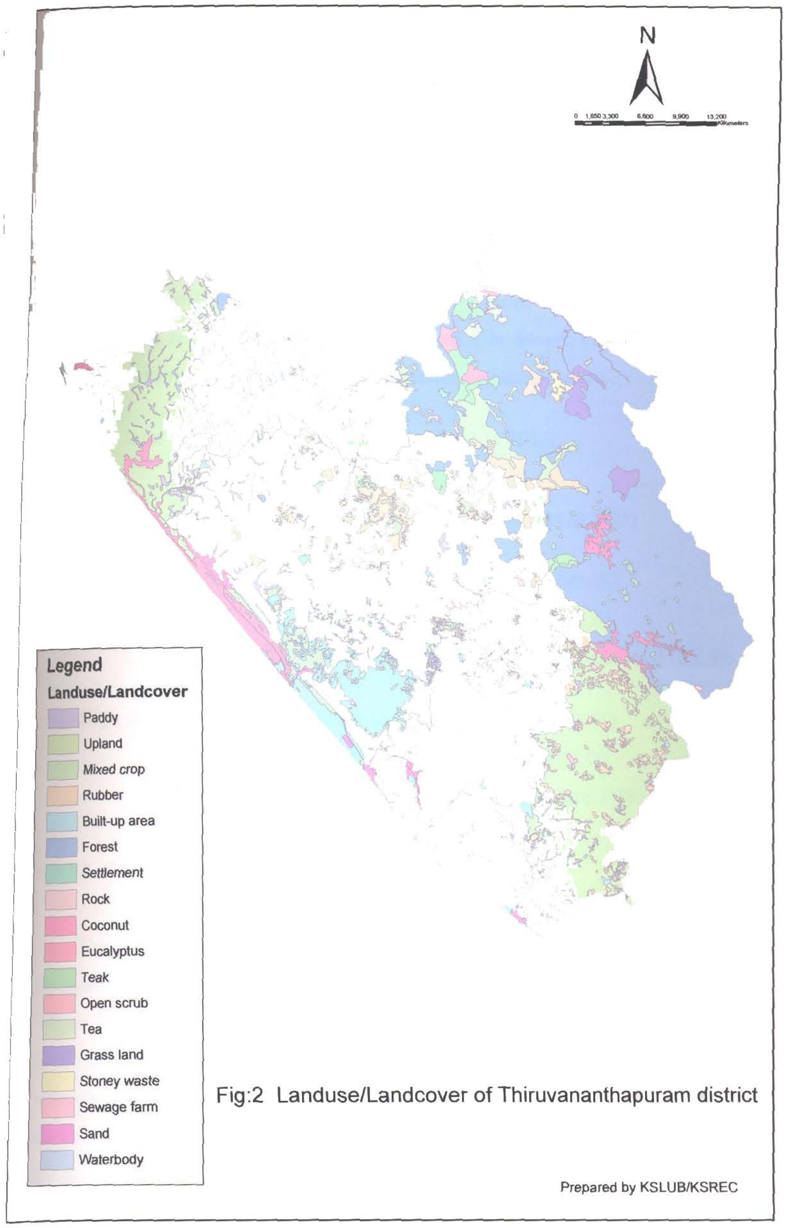

Fig:2 Landuse/Landcover of Thiruvananthapuram district

Class III, Class IV, Class VI and Class VIII lands. These land classes has the limitations of erosion, soil and wetness.

3.1.1.1.5 Agro-Ecological Situation

The district possesses different agro-ecological situations which have been identified on the basis of situation, altitude, soils and irrigation. As reported by Kerala State Land Use Board (1999) there are nine agro-ecological situations in the district as listed below.

Low land	1	Coastal wet land (CWL)
	2	Coastal dry land (CDL)
	3	Reclaimed back water areas (RB)
Mid land	4	Mid land wet condition (MLW)
	5	Mid land dry condition (MLD)
	6	Mid land dry situation-red loam soil (RLS)
High land	7	High land wet situation (HLW)
	8	High land dry situation (HLD)
	9	Homestead farming situation (HF)

3.1.1.2 Selection of sample watershed

The location for development of the 'spatial crop suitability' model for micro level planning was selected within the Neyyar river basin, the 'Major Watershed of Neyyar' as per the watershed atlas of Kerala State Land Use Board (1996). As per this atlas there are four major watersheds in Thiruvananthapuram district, namely Neyyar, Karamana, Mamom and Vamanapuram. Neyyar watershed was selected for deriving the first ever 'participatory and integrated crop suitability' model at micro watershed level in Kerala, since considerable baseline information on the watershed was available. More over this watershed was codified as number '1' by Kerala State Land Use Board and is the southern most major watershed of the State. Further it is the only watershed in Thiruvananthapuram district where the area is benefited by the Command Area Development Programme.

After studying the Survey of India maps, remote sensing data etc. and also after traversing the Neyyar watershed, a compact area with diversified agro-ecological situation within this major watershed was selected for deriving the model. The limitation of time, finance and other resources forced the researcher to limit the area to 3109.12 hectares falling in the mid land region of Neyyar river basin. The topography of the study area is undulating to rolling with land forms of valleys, foot slopes, side slopes and hill tops. The area fell in the portions of Neyyattinkara municipality, Maranallor and Kattakada panchayats of Aryancode, Pallichal and Kattakada blocks of Thiruvananthapuram district respectively. It is located between 8° 25'12" to 8° 30'47" North Latitudes and 77° 3'23" to 77° 6'34" East Longitudes. The watershed was named as 'Aruvipuram' with the prominant place name near the outlet area. The location map is given as Fig 3.

The main activity in the area is agriculture and animal husbandry. The area has predominantly a coconut based farming system with other crops viz., banana, vegetables, rubber, tapioca, pepper, mango, jack, fodder etc. The area had a good stretch of paddy field to the extent of 404 hectares during 1989-90 (as per Survey of India Topo maps). Due to the various constraints faced by the paddy growers, presently almost 99 per cent of this fragile ecosystem has been either converted for other purposes or put under other crops viz., banana, vegetables, coconut, tapioca etc.

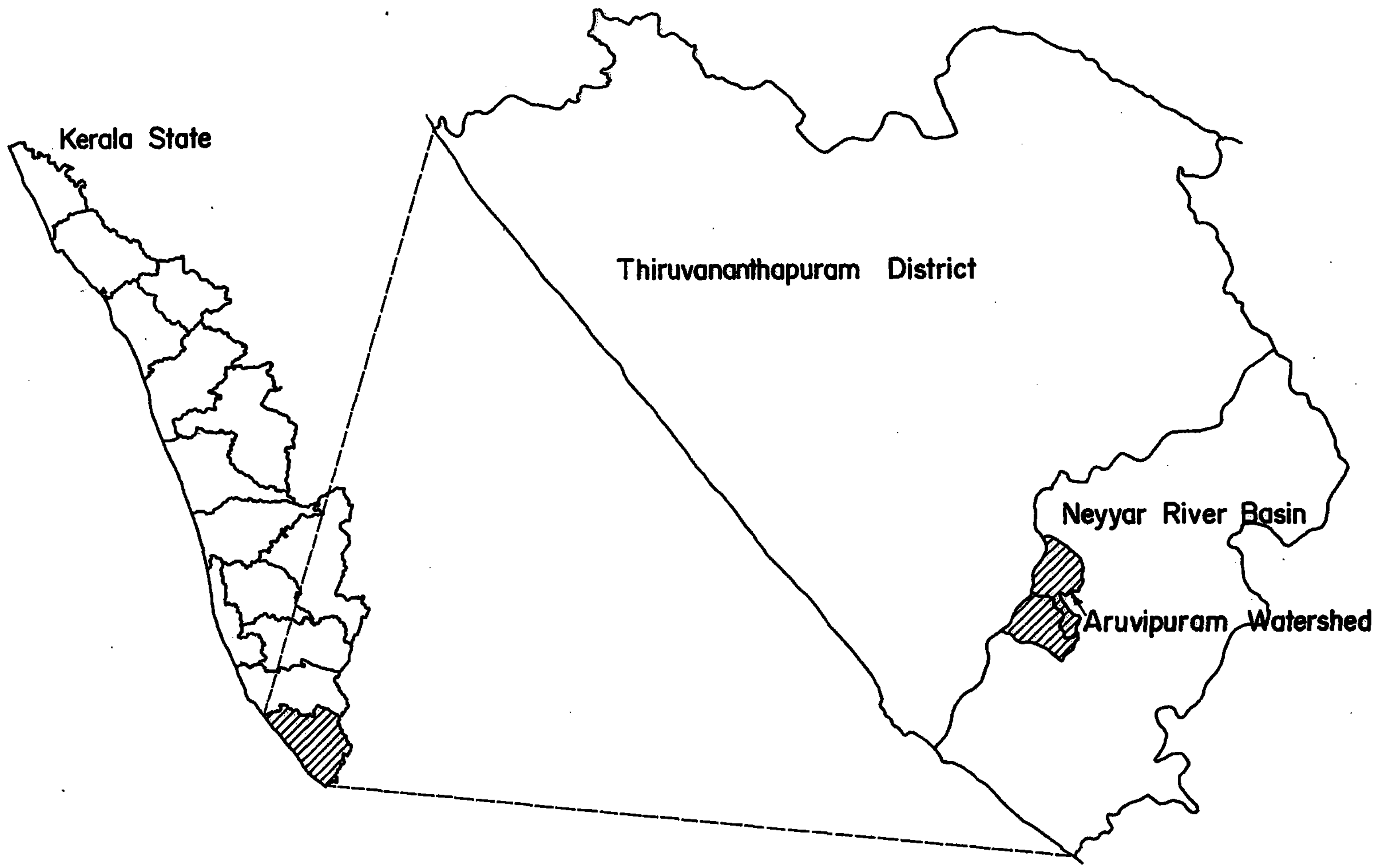

Fig. – 3 Location Map of Aruvipuram Watershed

The elevation of the area ranges from 140 m to <20 m above MSL. Similarly the slope ranges from gentle to steep. The area enjoys a humid tropical climate with good distribution of rainfall over South West, North East and summer periods. In general, the soils of the area are found to be good with texture ranging from sandy loam to clay loam. The soil depth ranges from moderate to very deep and the drainage condition is imperfectly drained to excessively drained. The area is subjected to varying degrees of erosion. The area has access to the markets of Vegetable and Fruit Promotion Council Kerala (VFPCK) and other markets located at Ooroottambalam, Kattakada and Balaramapuram. Substantial area is being benefited by the CADA project and in general the interest shown by the people towards agriculture was found to be good.

3.2 SELECTION OF FACTORS RELATED TO PARTICIPATORY AND INTEGRATED LAND EVALUATION FOR CROP SUITABILITY AIMED AT SUSTAINABLE AGRICULTURE DEVELOPMENT

The Q-sort technique with the use of 'Pusa rank sheet' developed by Babu and Singh (1984) was adopted in this study to finalise the most important biophysical and socio-economic factors to be considered for participatory and integrated land evaluation for crop suitability aimed at sustainable agriculture development.

The Q-sort method was devised originally by Stephenson (1936) for his heuristic studies. It is essentially a group-ranking method. The pre-fixing letter 'Q' has no special significance. In this technique, the respondents sort out the items into a number of categories or piles, each having a specified number of items as required to form a normal distribution. The categories are placed in rank order with the highest rank containing most important items and the lowest rank with the least important items. As reported by Singh (1993) the number of items to be sorted must not be less than 60 and more than 140. In the words of Kerlinger (1983), the Q-sort procedure "is far more interesting. Most persons seem to enjoy sorting Q-decks perhaps because the method is both challenging and realistic".

In the Q-sort method, the response can be collected either through interview or mail. The respondents are asked to return the cards containing the items after sorting and clipping them in various categories and keeping them together with the help of rubber bands. This procedure is cumbersome, involves high mailing cost and inconvenience. These limitations are eliminated by using the 'Pusa rank sheet for Q-sort'.

With the 'Pusa rank sheet' the judges are asked to enter the code numbers of the items given in the respective cards in the appropriate boxes of each pile or category in the rank sheet. Apart from economy and convenience in mailing, Pusa rank sheet of Q-sort has the following advantages also as explained by Babu and Singh (1984);

i) The cards are left with respondents as a souvenir.

ii) It ensures that no card has been left unranked.

iii) It ensures that only the required number of items have been put in a given category.

iv) Rank sheet is handy for computerising the data.

v) When interview method is adopted for data collection, the investigator need to carry only one set of cards and note down the code numbers in the rank sheet for each administration.

Pusa rank sheet consisted of a nine-point judgemental continuum. Jaiswal (1965), Jha (1968) and Kaleel (1993) used a nine-point judgemental continuum of Q-sort ratings in their studies under Indian conditions. Hence in the present study also it was decided to resort to the nine categories by using the Pusa rank sheet for Q-sort developed by Babu and Singh (1984).

The 'Forced choice Q-sort' technique employed in the present study was in line with the procedure of Q-sort explained by Singh (1993). It involved the following steps.

3.2.1 Fixing the number of factors to be sorted

More than 100 biophysical and socio-economic factors required for land evaluation to derive crop suitability at micro watershed level were documented through intensive search of literature and discussion with experts/subject matter specialists concerned with land evaluation for agriculture development. These factors were critically analysed to eliminate ambiguity and repetitiveness. Through discussion with selected scientists of Kerala Agricultural University and other experts in land evaluation, 80 biophysical/socio-economic factors as given in Appendix I were finally selected for using in the Pusa rank sheet for Q-sort for the study.

3.2.2 Preparation of cards

The 80 factors with their operational definition were printed seperately on 80 numbers of cards of size 14 cm x 9 cm. A code number for each item was provided on the top right hand corner of the card. Such 80 cards constituted one set. Similarly sufficient number of sets were prepared to be given to the selected judges for sorting.

3.2.3 Sorting procedure

One set of eighty cards along with the rank sheet, instructions, self addressed stamped envelop, rubber bands etc. with request were either handed over in person or through mail to selected forty judges. They consisted of Scientists of Kerala Agricultural University/ICAR institutions, Subject Matter Specialists of Department of Agriculture, retired experts of Government of India / State Government etc. who had sufficient knowledge and experience in land evaluation for agriculture development. They were asked to sort the eighty factors into nine piles as envisaged in the 'Pusa rank sheet for Q-sort'. Copies of request, rank sheet and instruction are furnished as Appendix II. According to 'Pusa Q-sort' the judges need return only the rank sheet and not the cards as in the case of 'Q-sort'.

3.2.4 Analysis of data received after Pusa Q-sort

The responses were received back from only thirty judges. These responses were subjected to correlation analysis to study the correlation among the judges in sorting of items as explained by Singh (1993). The correlation matrix was generated. On its basis, the rank sheet of the judges that lack significant correlation with atleast one of the other judge was eliminated in using it for final selection of the most important factors for participatory and integrated land evaluation for sustainable agriculture.

3.2.5 Final selection of factors

To understand the exact way of sorting by the judges and to examine the judges preference to the factors in lower or upper piles, the Q-sort data of the judges having significant correlation were examined.

From their rank sheets, nineteen items falling in the upper three piles in each rank sheet were considered to be the 'most important factors' for land evaluation to derive crop suitability. These nineteen factors fell in the first three piles namely, 'most important', 'highly important' and 'very important' respectively.

To finally select the nineteen factors, the first nineteen items sorted by the judges with significant correlation were subjected to further analysis. In this process, weightage scores of 3, 2 and 1 were given to the items falling in 'most important', 'highly important' and 'very important' categories respectively. The total weightage scores obtained for each item as per the sorting by all the judges were prepared and arranged in descending order on the basis of the total weightage scores. From this, 19 items with higher weightage scores were considered as the critical or most important factors for participatory and integrated land evaluation for deriving crop suitability aimed at sustainable agriculture development at micro watershed level in Kerala.

3.3 SELECTION OF THE RESPONDENTS

The respondents of this study consisted of both Agricultural Officers and farmers. To study the conative response of Agricultural Officers towards the concept and techniques of land evaluation, all the Agricultural Officers working in Thiruvananthapuram district were considered as respondents.

To study the conative response of farmers towards 'spatial crop suitability' model, thirty farmers of the Aruvipuram watershed area were selected. The watershed covered portions of Perumpazhuthoor, Maranalloor and Kattakada Krishi Bhavan area. Hence from the list of progressive farmers in the watershed area available with these Krishi Bhavans, thirty farmers were selected at random. So 120 Agricultural Officers of Thiruvananthapuram district and 30 farmers of Aruvipuram watershed formed the respondents of the study. Out of 120 Agricultural Officers, response were received back from only 100 respondents. Hence final number of respondents for the study were 100 Agricultural Officers and 30 farmers.

3.4 SELECTION OF THE VARIABLES FOR THE STUDY

3.4.1 Dependent variables

The conative response of Agricultural Officers towards land evaluation were studied through their awareness, knowledge and attitude towards the concept and techniques of land evaluation for sustainable agriculture development. Hence awareness, knowledge and attitude formed the dependent variables of the study.

3.4.2 Independent variables

A set of profile characteristics of the Agricultural Officers constituted the independent variables. Through review of literature and discussion with experts/scientists/officials, a set of seventeen profile characteristics were finalised for the purpose of this study. The variables were sex, age, educational status, rural/urban background, training received, job experience, cosmopoliteness, exposure to Internet/IT, entrepreneurial behaviour, innovation proness, self confidence, scientific orientation, achievement motivation, attitude towards profession, job satisfaction, job involvement and organizational climate.

3.5 OPERATIONALISATION AND MEASUREMENT OF DEPENDENT VARIABLES

3.5.1 Awareness

For the purpose of this study the variable awareness was operationally defined as the extent of first hand information possessed by the Agricultural Officer about land evaluation for sustainable agriculture development.

The methods employed by few researchers to measure this variable are presented below.

Salunkhe (1978) measured awareness of farmers by asking questions on different aspects of SFDA activities and giving score for each correct answer.

Cherian (1984) studied the awareness of farmers and Village Extension Workers by asking a few questions on T&V system. A score of 'one' was given for each correct answer and 'zero' for wrong answer. Individual total score gave the awareness score.

Srinath (1988) used an interview schedule to assess the awareness of prawn farmers towards scientific prawn farming.

Fathimabi (1993) in a study on the awareness of agricultural labourers about the modus operandi of KAWPS and KAWWFS, prepared a set of questions in consultation with officials and reviewing the literature. These questions were included in the interview schedule. A score of 'one' was given for correct answer and 'zero' for wrong answer. The scores were added up to get the awareness score of each respondent.

Ashaletha (2000) used a teacher-made questionnaire to measure the awareness of farmers about NARP. A score of 'one' was given to favourable answer and 'zero' to unfavourable answer. All the scores were totaled up for getting individual awareness score.

In the present study a 'teacher-made test' of fifteen items was developed to measure this variable in consultation with experts, scientists and officials concerned with land evaluation for agriculture development and also by reviewing relevant literatures. These items were included in the mailed questionnaire sent to Agricultural Officers.

A score of 'one' was given to the correct answer and 'zero' to wrong answer. The individual awareness score was obtained by adding up the score of all fifteen items. Thus the maximum scores that could be obtained by a respondent was '15' and least was '0'.

3.5.2 Knowledge

Knowledge was the next dependent variable of this study. This variable was operationally defined as the quantum of technical know-how possessed by the Agricultural Officers on land evaluation for agriculture development.

A brief presentation of the measurement techniques used by different researchers to measure this variable is given in Table 2.

Table 2. Details of researchers with the tests used for measuring knowledge

Researchers	Year	Respondents	Measurement technique
Salvi	1970	Rural farmers	Teacher made test
Singh and Singh	1974	Farmers	Knowledge score = $\frac{X_1}{N} \times 100$ (X_1 - No. of correct answers N - Total number of questions)
Meera	1981	Farm women	Knowledge index = $\frac{\text{Number of correct answers}}{\text{Total score possible}} \times 100$
Anantharaman	1991	Cassava farmers	-do-
Manjusha	2000	Cowpea growers	Teacher-made test
Singh *et al.*	1999	Farmers	Knowledge (%) = $\frac{\text{Total obtained score}}{\text{Maximum possible score}} \times 100$
Ashaletha	2000	Farmers	Teacher-made test
Sreedaya	2000	Vegetable growers	-do-
Thomas	2000	Medicinal plant growers	Free tailed questionnaire and answers cross checked.

A standardised knowledge test was developed for this study to measure the knowledge level of Agricultural Officers of Thiruvananthapuram district, Kerala State about land evaluation for sustainable agriculture development. The procedure consisted of following steps.

1. Selection of items
2. Item analysis
    i) Item difficulty index
    ii) Item discrimination index
3. Reliability
4. Validity
5. Method of scoring
6. Categorisation of respondents

3.5.2.1 Selection of items

The knowledge test consisted of questions termed as items. Through review of literature, discussions with scientists/subject matter specialists/officials concerned with land evaluation for agriculture development, an item pool of questions was prepared. Then scrutiny of the item pool was carried out with the support of subject matter specialists and those items which were expected to differentiate the well knowledgeable respondents from the poorly knowledgeable ones and also having certain level of difficulty were finally selected after necessary editing. Thus the initially finalised knowledge test consisted of twenty five items of multiple choice type.

3.5.2.2 Item Analysis

The initially selected twenty five items on land evaluation for sustainable agriculture development were administered to fifty randomly selected non-sample respondents, namely the Agricultural Officers of Thrissur district, Kerala State (Appendix III). Out of the fifty, only thirty six responded. This 36 formed the category of non-sample respondents for the knowledge test. Their responses were subjected to item analysis which yielded two kinds of information, namely item difficulty and item discrimination.

3.5.2.2.1 Item difficulty index

The item difficulty index revealed how difficult an item was. It was determined on the basis of the responses from only a portion of the respondents. For each item, a score of 'one' was given to the correct answer and 'zero' to the incorrect response. Thus there was a possibility of respondent scoring a maximum of twenty five points for all correct responses and zero points for all wrong responses.

The thirty six respondents were ranked in the descending order of total scores from highest to the lowest. Then the upper 27 per cent and lowest 27 per cent were seperated. They were termed as the upper and lower group respectively. The remaining 46 per cent was set aside and the index of difficulty of each item was determined on the basis of the response from 54 per cent, namely the upper and lower groups. The formula used to determine the difficulty index was

$$\rho = \frac{R_U + R_L}{N_U + N_L}$$

where,

ρ - index of difficulty

R_U - number of respondents answering correctly in upper group

R_L - number of respondents answering correctly in lower group

N_U - number of respondent in upper group

N_L - number of respondent in lower group

The item numbers with their corresponding 'ρ' value are shown in Appendix IV. From this, the items with 'ρ' value ranging from 0.30 to 0.70 were considered for final selection.

3.5.2.2.2 Item discrimination Index

The second criterion for item analysis, namely item discrimination index was worked out using the method of Marshall and Hales (1972) as explained by Singh (1993). This is a very simple and quick method of determining the index of discrimination, which is termed as 'Net D index of discrimination'. This has been defined by them as an unbaised index of absolute difference in the number of discriminations made between the upper and lower group - it is proportional to the net discriminations made by the item between two groups.

Net D method also involved analysis of the response of two extreme groups namely the upper group constituting 27 per cent and lower group constituting 27 per cent of the examiners. This method was directly based upon the difference between the proportion of correct answers of top 27 per cent and bottom 27 per cent respondents. Net D (V) was worked out using the formula

$$V = \frac{R_U - R_L}{N_U} \quad \text{(because } N_u = N_L\text{)}$$

Here R_U and R_L referred to the number of respondents that gave correct answer in the upper and lower group respectively. N_U and N_L represented the number of respondents in the upper and lower groups respectively. The Net D values for all the items are given in Appendix IV. The items with Net D values ≥ 0.30 were considered for the final selection.

3.5.2.3 Reliability

The test-retest method was used for assessing the reliability of the test. For the purpose, the developed knowledge test was administered to thirty Agricultural Officers of Kollam district selected randomly. The two administrations were within a time gap of fifteen days. The individual scores of each respondent for the two administrations were worked out. The product moment correlation was found to be 0.78 which was significant at 0.01 level. It showed that the test was reliable.

3.5.2.4 Validity

The knowledge test developed for the study was tested for its content validity. Proper care was taken to include items covering the entire universe of relevant aspects of knowledge with respect to the subject matter on land evaluation for sustainable agriculture development. Items were finalised in consultation with subject matter specialists in land evaluation as well as scientists of Kerala Agricultural University. Hence it is assumed that the test could measure the knowledge of the respondents with validity.

3.5.2.5 Method of scoring

The respondents of the study namely the Agricultural Officers of Thiruvananthapuram district were asked to indicate their responses to final knowledge test of thirteen items given in Appendix VI.

The individual knowledge score was worked out using the procedure of Singh and Singh (1974). The formula was $\frac{X_1}{N} \times 100$

where

X_1 - number of correct answers

N - total number of items (13)

3.5.2.6 Categorisation of the respondents

Using the knowledge score of the respondents, they were grouped into low, medium and high level of knowledge with respect to land evaluation for sustainable agriculture on the basis of mean and standard deviation of the sample.

3.5.3 Attitude

Attitude was the third dependent variable of the study. For the purpose of this study, attitude was operationally defined as the degree of positive or negative feeling possessed by the Agricultural Officers towards the concept and use of land evaluation for crop suitability aimed at sustainable agriculture development.

Researchers had attempted to measure this variable under different situations using different attitude scales developed through different measurement techniques. Few of them are presented in Table 3.

Table 3. Details of researchers with the measurement techniques used to measure attitude

Researchers	Year	Respondent	Measurement techniques
Singh and Sinha	1970	Farmers	Sematic differential techniques
Gupta and Sohai	1976	Dairy farmers	Scale - Discrimination techniques of Edwards and Kilpatrick of 1948
Samad	1979	Junior Agricultural Officers, Farmers	Scalogram analysis
Bhatnagar and Singhal	1984	Women	Equal appearing interval
Prajapati and Patel	1984	Extension workers	Likert's summated rating
Chandrakandan and Knight	1987	Farmers	Equal appearing interval
Srinath	1988	Prawn farmers	Equal appearing interval
Anantharaman	1991	Cassava farmers	Likert's summated rating
Sagar *et al.*	1992	Livestock owners	Likert's summated rating
Fathimabi	1993	Agricultural labourers	Equal appearing interval
Saravanan *et al.*	1999	Farmers, Extension Personnel & Scientists	Likert's summated rating
Prasad, S	2000	Parents	Likert's summated rating

In the present study this variable was measured with the help of an attitude scale constructed following the Likert's summated rating method as described by Edwards (1957). It consisted of the following steps.

1. Collection of items
2. Item analysis
3. Reliability
4. Validity
5. Scoring

3.5.3.1 Collection of items

Initially, statements reflecting views for and against land evaluation for crop suitability were collected through review of literature and discussion with experts/subject matter specialists/officials of the Department of Agriculture. Care was taken to develop a universe of content that would reflect the attitude of Agricultural Officers towards the stimulus under study. Thus a total number of sixty statements were collected. After editing them based on the criteria suggested by Edwards (1957), forty four statements as furnished in Appendix III were retained for the initial test.

3.5.3.2 Item analysis

To select the statements to be included in the final scale, the edited forty four statements were given to eighty randomly selected Agricultural Officers of Thrissur district who formed the non-sample respondents for the purpose. The respondents were asked to give their responses on a five-point rating scale viz. strongly agree, agree, undecided, disagree and strongly disagree. Weightages of 5, 4, 3, 2 and 1 were given to the responses respectively in the case of positive statements and the weightages were reversed in the case of negative statements.

Out of eighty respondents, only sixty responded. Hence this sixty formed the non-sample respondents in the initial test. The total score of each respondent was calculated by summing up the scores of all statements. Following the procedure explained by Edwards (1957), 25 per cent of the respondents with highest total scores and 25 per cent with lowest total scores were selected to form the criterion groups to compute the critical ratio of each statement discriminating the two groups. The critical ratio (t-value) for each item was calculated using the formula given below. The 't' values are given in Appendix VI.

$$t = \frac{\overline{X}_H - \overline{X}_L}{\sqrt{\dfrac{S_H^2}{n_H} + \dfrac{S_L^2}{n_L}}}$$

where

$\overline{X}_H$ the mean score on a given statement for the high group

$\overline{X}_L$ the mean score on a given statement for the low group

S_H^2 the variance of the distribution of responses of the high group to the statement

S_L^2 the variance of the distribution of responses of the low group to the statement

n_H the number of subjects in the high group

n_L the number of subjects in the low group

The value of 't' is a measure of the extent to which a given statement differtiates between the high and low group. According to the rule of thumb, any value of 't' equal to or greater than 1.75 only were considered for final selection. Thus eight positive statements and seven negative statements with maximum 't' values as shown in Appendix VI were selected.

3.5.3.3 Reliability

The reliability of the scale was measured using test-retest method. Here the developed scale of fifteen statements were administered twice at fifteen days interval to thirty Agricultural Officers of Kollam district selected randomly. The two sets of attitude scores were correlated using product moment correlation and the correlation coefficient (r) was found to be 0.82, significant at 0.01 level indicating that the scale was reliable.

3.5.3.4 Validity

The scale was examined for the content validity by determining how well the contents of the scale represented stimulus under study. Great care was taken to include all the items to represent the universe of content relevant to the topic under study by referring to relevant literatures and discussion with experts/subject matter specialists/officials. Hence it was assumed that the scale was considered to have content or intrinsic validity. The final scale consisted of fifteen statements which were included in the final questionnaire sent to Agricultural Officers (Appendix V).

3.5.3.5 Scoring

Attitude of Agricultural Officers towards land evaluation for crop suitability was measured by administering the final scale to all the 120 Agricultural Officers working in Thiruvananthapuram district through mailed questionnaire. Out of 120, responses were received back from only 100 respondents. Then the individual total score was worked out by summing the scores of all fifteen statements with weightages of 5, 4, 3, 2 and 1 for Strongly Agree, Agree, Undecided, Disagree and Strongly Disagree for positive statements and reverse in the case of negative statements.

On the basis of mean and standard deviations, the respondents were grouped as :

Individuals with unfavourable attitude,

Individuals with favourable attitude

and individuals with highly favourable attitude

3.6 OPERATIONALISATION AND MEASUREMENT OF INDEPENDENT VARIABLES

The independent variables in this study represented the profile characteristics of the Agricultural Officers which may or may not have relationship with their awareness, knowledge and attitude towards land evaluation for agriculture development. A list of profile characteristics were prepared through review of literature and discussion with experts. Finally seventeen characteristics were selected with the assistance of scientists of College of Agriculture, Vellayani. The variables are presented below.

3.6.1 Sex

It is a dichotomised variable, having only two categories namely 'male' and 'female'. For the purpose of this study, it refers to the male and female Agricultural Officers of the Department of Agriculture, Kerala State who are employed in Thiruvananthapuram district.

Quantification of this variable was done at nominal level of measurement. A score of 'one' was given to male and 'two' to female respondents.

3.6.2 Age

It refers to the number of calendar years completed by the respondent at the time of enquiry.

To measure this variable, the number of completed years was as such considered as the score of the respondent for this variable.

3.6.3 Educational status

It refers to the highest academic qualification possessed by the Agricultural Officer from the discipline of Agriculture.

To identify the respondents on this variable, a score of '1' was given for Diploma or its equivalent, '2' for Bachelors degree, '3' for Master's degree and '4' for Doctoral degree.

3.6.4 Rural / Urban background

This was operationalised for the purpose of this study as panchayat area/municipal area/corporation area with respect to the location of the native place of the respondent.

To quantify this variable the following scores were offered

Background	Score
Panchayat area	3
Municipal area	2
Corporation area	1

3.6.5 Trainings received

It refers to the knowledge and skills acquired by the Agricultural Officer in agriculture and allied activities through pre-service and inservice training programmes.

A score of '1' was given for each completed week of training received by the respondent.

3.6.6 Job Experience

It refers to the total number of completed years of service as Agricultural Officer in the State Department of Agriculture or in other agencies in the related field.

A score of '1' was assigned to each completed year of experience.

3.6.7 Cosmopoliteness

It refers to the degree to which the Agricultural Officer was oriented to his surrounding social system, such as visiting to the nearest town/city and also purpose of visit.

This variable was measured using the procedure adopted by Desai (1961) with necessary modification. The scoring procedure followed was as follows.

a) Frequency of visit

Frequency of visit	Score
Twice or more a week	5
Once in a week	4
Once in a fortnight	3
Once in a month	2
Very rarely	1
Never	0

b) Purpose of visit

Purpose of visit	Score
All visits for official purpose	4
Some visits for official purpose	3
Personal/Domestic purpose	2
Entertainment purpose	1
Other purposes	0

The sum of scores of (a) and (b) formed the score on cosmopoliteness of the respondent.

3.6.8 Exposure to Internet and Information Technology

It refers to the extent to which the Agricultural Officer was using the support of internet and information technology (Internet/IT) for developing his/her knowledge and skills for the benefit of his/her profession.

The scoring procedure was as follows

Exposure	Score
Always	3
Frequently	2
Some times	1
Never	0

3.6.9 Entrepreneurial behaviour

It refers to the ability of the Agricultural Officers to exploit the opportunities and initiate an enterprise of his/her own for income generation.

To measure this variable the schedule used by Surendran (2000) with necessary modifications was adopted. The responses of Agricultural Officer was obtained on a five-point continuum from strongly agree to strongly disagree and the scoring pattern was 5 to 1 for positive statements and reverse for negative statements. The total score formed the score of entrepreneurial behaviour of the respondent.

3.6.10 Innovation proneness

It refers to the behaviour pattern of Agricultural Officers who have interest and desire to bring in sustainable agriculture development in his/her jurisdiction by introducing new techniques in crop selection and management.

The self rating scale used by Ashaletha (2000) with necessary modification was used to measure the variable for the purpose of this study. The scale consisted of three sets of statements. The respondents were asked to select the one amongst the three from each set which most accurately portrayed them and another which suit them least accurately. Thus the respondent's 'most suitable' and 'least suitable' item from each set was obtained. The three statements from each set were weighted 3, 2 and 1 respectively for high, medium and low level of innovation proneness.

The ratio of weightage of 'most suitable' to 'least suitable' statements in each set was worked out. Then ratio of three sets of statements were summed to get the respondent's self rating score for innovation proness.

3.6.11 Self confidence

It refers to the belief of the Agricultural Officer in his/her abilities, initiative and zeal to achieve the goal in his/her profession.

This variable was measured by the scale used by Seema (1997) with slight modification. The scale consisted of eight statements with four positive and four negative statements. The responses were obtained on five point continuum namely strongly agree, agree, undecided, disagree, strongly disagree with weightage 5, 4, 3, 2 and 1 respectively for positive statements and reverse for negative statements. The possible scores varied from 8 to 40.

3.6.12 Scientific orientation

It refers to the degree to which the Agricultural Officer is oriented to the use of scientific techniques for decision making in crop selection and its management.

The scale used by Surendran (2000) with necessary modification was used in this study to measure this variable. The scale consisted of six statements. The scoring pattern was 5, 4, 3, 2 and 1 for strongly agree, agree, undecided, disagree and strongly disagree respectively for positive statements. The scores were reversed for negative statements. Summation of scores for all the items gave the score of the respondent with respect to his/her scientific orientation.

3.6.13 Achievement motivation

It refers to the motive or desire within the Agricultural Officer to successfully complete a task and to derive the desired goal or attain a given standard of excellence.

This variable was measured with the scale used by Nehru (1993). It consisted of seven statements to be rated on a five point continuum namely strongly agree, agree, undecided, disagree and strongly disagree with scores 5, 4, 3, 2, 1 respectively. The possible score varied from 7 to 35.

3.6.14 Attitude towards Profession

It refers to the positive or negative affect of the Agricultural Officer towards his/her profession.

To measure this variable the measurement procedure used by Nehru (1993) was adopted in this study. The scale consisted of ten statements of which five were positive and five were negative. The responses were obtained on a five point continuum namely strongly agree, agree, undecided, disagree and strongly disagree with weightage of 5, 4, 3, 2 and 1 respectively for positive statements and the weightage was reversed for negative statements. The possible scores ranged from 10 to 50.

3.6.15 Job Satisfaction

It refers to the degree of satisfaction or dissatisfaction of Agricultural Officers with regard to the different aspects of their job.

This variable was measured using a scale developed by Sridhar (1977) with necessary modification. The responses were collected on a three point continuum namely very much satisfied, satisfied and dissatisfied with weightages of 3, 2 and 1 respectively. The instrument had 18 items and hence the minimum score that could be obtained by a respondent was 18 and maximum was 54.

3.6.16 Job Involvement

It refers to the degree to which an Agricultural Officer has identified himself/herself with his/her work.

The scale used by Nehru (1993) with necessary modification was used to measure the variable for the purpose of this study. The scale consisted of 20 statements. The response to each statement was collected on a three point continuum of strongly agree, agree and disagree with scores of 3, 2 and 1 respectively for positive statements and the scoring was reversed for negative statements. The total score of each respondent was obtained by summing up the scores on all the twenty items.

3.6.17 Organizational Climate

It refers to the degree to which an Agricultural Officer perceives about his work place, facilities available, his co-workers, guidance, supervision, encouragement, leadership etc. To measure this variable the scale developed by Prasannakumar (1985) and adopted by Nehru (1993) with slight modification was used in this study. The scale consisted of seven items representing the different dimensions of organizational climate. The response was obtained on a three point continuum of agree, somewhat agree and disagree with weightages of 3, 2 and 1 respectively. The total score of a respondent was obtained by summing up the weightages got on all the items.

3.7 DEVELOPMENT OF 'SPATIAL CROP SUITABILITY' MODEL AT MICRO WATERSHED LEVEL THROUGH PARTICIPATORY AND INTEGRATED LAND EVALUATION FOR SUSTAINABLE AGRICULTURE DEVELOPMENT

An attempt was made by the researcher to develop a methodology for spatial crop suitability recommendation at micro watershed level under Kerala situation for sustainable agriculture. Due to time and financial constraints, the study was limited only to the major crops suitable for the watershed area. This was envisaged through the concept of 'participatory and integrated land evaluation'. The location was

'Aruvipuram watershed' of Neyyar river basin. As per the watershed atlas of the Kerala State Land Use Board (KSLUB), the area fell in the watershed code numbers of 1N6a and 1N7a in the major watershed of Neyyar. The methodology involved the following eight major steps.

3.7.1 Base map generation

Initially with the help of Survey of India topomap on scale 1:25000 a base map on 1:10,000 scale was generated using the cartographic facilities in the Kerala State Land Use Board (KSLUB). This was in line with the recommendation No.6 of the plenary session of the State level seminar conducted by the KSLUB in 2002, which was submitted to Government for necessary action. The recommendation was to prepare 'resource based land suitability spatial data' for the entire State on a scale 1:10,000 or larger. The study area of 3109.12 hectares was further divided into different agro-ecological situations on the basis of land situation, attitude, soils and irrigation. Then major roads and locations were included. This formed the base map of the present study.

3.7.2 Micro watershed delineation and codification

The procedure adopted by the KSLUB in delineation and codification of watersheds was used for the delineation and codification of micro watersheds in this study also. Accordingly the area under 1Na6 watershed as per the KSLUB atlas was further delineated into six micro units through the interpretation of black and white aerial photographs on 1:15,000 scale available at the KSLUB. This was repeated for 1Na7 watershed also and it was delineated into nine micro units. Thus the entire area was delineated and codified into 15 micro watersheds for the purpose of this study.

3.7.3 Study of micro watershed characteristics

The characteristics of the micro watersheds reflect their inherent potential for any development activity. This was essential for watershed planning. In the present study the characteristics studied were size, shape, major crops grown, erosion status and drainage pattern. This was assessed with the help of micro watershed map, satellite data (LISS III IRS), aerial photographs and limited ground truth. This information was useful at the time of deciding the type of land use, crops etc. suitable for each micro watershed.

3.7.4 Collection of secondary data

This step involved the collection of all available secondary data with respect to the land and water resource of the study area. It consisted of large scale soil map and reports from State Soil Survey Organization, ground water information from State Ground Water Department, meterological data representing the area from the Centre for Water Resource Development and Management (C.W.R.D.M) sub centre at Neyyattinkara and other informations such as soil test data, crops grown, nearest markets, details of farmers etc. from the Krishi Bhavans of Perumpazhuthoor, Maranalloor and Kattakada.

3.7.5 Generation of primary spatial data

With the help of secondary data, remote sensing data (satellite data and aerial photographs), topomaps and limited ground truth, thematic maps on 1:10,000 scale were generated for the biophysical factors selected through Q-sort technique. In the case of factors for which spatial data could not be generated, non-spatial secondary data representing the area was used in this study.

3.7.6 Participatory approach for land evaluation

The primary spatial data generated was evaluated through the method of Participatory Appraisal of Natural Resources (PANR) as suggested by Mukherjee (1997). Different tools have been recommended for the purpose. In the present study the following tools were used for participatory land evaluation as per requirement.

i) On the spot visualization
ii) Key informant interview
iii) Joint walk
iv) Resource analysis

Besides the use of the above tools, three group interviews of the local farmers were held in three different locations of the study area. The details are given in Table 4. Through this process the problems faced by the farmers, potentials of the area, indigenous knowledge, farmer's choice to farming systems and crops, details on the socio-economic factors related to farming etc. were documented. These information were vital in deriving the spatial crop suitability recommendations for the study area.

Table 4. Details of Group Interviews held for participatory land evaluation

Sl. No.	Location	Date and time	Number of participants attended
1	Maranallur	2-05-2003 (2.30 PM - 5.30 PM)	15
2	Perumpazhuthur Krishi Bhavan	8-05-2003 (10.00 AM - 1.00 PM)	14
3	Razalpuram	8-05-2003 (3.00 PM - 5.30 PM)	10

The list of key informants and farmers were collected from the respective Krishi Bhavans. Through the process of this participatory land evaluation, necessary corrections were made and the primary spatial data were finalised for integrated land evaluation.

3.7.7 Fixing standards for the factors of land evaluation for crop suitability

Land evaluation for spatial crop suitability was envisaged in the present study inline with the method of 'Qualitative land suitability' evaluation (Factor rating method) prescribed in the FAO guidelines of land evaluation for rainfed agriculture of 1983. The FAO guidelines are given in Table 5.

Table 5. Definitions of FAO suitability classes employed for assessment in terms of individual land qualities (Factor rating)

Factor rating class	Definition in terms of yield: expected crop yields, as a percentage of yields under optional conditions, in the absence of inputs specific to the land quality considered.	Definition in terms of inputs: inputs or management practices, specific to the land quality considered, necessary to achieve yields of 80% of those under optimal conditions
S1	>80%	None
S2	40-80%	inputs needed, which are likely to be both practicable and economic
S3	20-40%	inputs needed, which are practicable but only economic under favourable circumstances
N	<20%	limitation can rarely or never be overcome by inputs or management practices.

The crop suitability classification of FAO consisted of four classes namely S1 - highly suitable; S2 - moderately suitable; S3 - marginally suitable and N - not suitable. This gave the extent to which a crop is suitable to a particular land unit in terms of the existing biophysical factors of that land unit. The FAO method of qualitative land suitability, also termed as the 'Factor rating' method involved two parallel set of criteria as explained in the Table 5.

The yield percentages are only approximate guidelines and may vary according to economic conditions; thus a yield reduction upto 40% might be acceptable to a subsistence farmer.

Sehgal *et al.* (1994) generated a suitability map of Nagpur district for cotton crop based on the simple limitation approach of FAO, which is a qualitative approach. In the present study the spatial crop suitability for S1, S2 and S3 namely highly suitable, moderately suitable and marginally suitable respectively was generated for the watershed area in line with the factor rating classification of FAO in terms of yield. This needed quantification of the biophysical factors for each crop under each suitability class. Such an attempt was made by Sys (1985) for some of the most important tropical and sub-tropical crops. According to him, it has to be considered as a guideline, such that the limitation levels for different biophysical factors for each suitability class must be reviewed to suite the local conditions. Similar attempt was made at macro level for Kerala State by the Kerala State Land Use Board (1997).

As there existed no other location specific standards of biophysical parameters for crop suitability for Kerala, on the basis of the above two references, Package of practices of Kerala Agricultural University (2003) and discussions with the Scientists of Kerala Agricultural University /

Officers of Department of Agriculture, the researcher had made an attempt to standardize the limits of the most important biophysical factors (selected through Q-sort) for each suitability class with respect to the major crops for the purpose of this study and the same are furnished as Appendix VII.

3.7.8 Integrated land evaluation

The process of integrated land evaluation involved two steps namely (i) integration of biophysical factors (ii) integration of socio-economic factors.

3.7.8.1 Integration of biophysical factors

Chinene and Shitumbanuma (1988) conducted the land evaluation and land suitability study of Musaba State farm in Zambia using the FAO guidelines on land evaluation. The procedure involved matching of land qualities and the requirements of land use type. Similar type of matching exercise was the procedure adopted by the Kerala State Land Use Board (1997) for a macro study of Kerala State.

In the present study it was not possible to obtain the location specific data on rainfall and temperature for the study area due to absence of meterological station in the watershed area. Hence the rainfall and temperature non-spatial data pertaining to an adjacent watershed area of 'Chittar' obtained from C.W.R.D.M. sub centre, Neyyattinkara was used as the representative data for the entire watershed.

For integrating the data of biophysical factors for the purpose of the study, initially the individual layers of spatial data on

1:10,000 scale (except rainfall and temperature) were digitized and loaded as input information on the Geographical Information System (GIS) using the GIS (ARC/INFO) facility available at KSLUB. Then integration of these biophysical spatial layers were carried out in GIS using the UNION facility of ARC/INFO.

The above process yielded a number of integrated polygons, termed as 'land mapping units' as expressed by Dent and Young (1981). Here the system was given a condition to generate land mapping units of size $\geq$ 0.20 hectares only. A map on 1:10,000 scale showing the spatial distribution of the 'Land Mapping Units' with system provided ID numbers and the micro watershed boundary overlayed was generated for finalising the spatial crop suitability recommendations of the watershed. This map with tabular description of the parameters of land mapping units was considered on the 'spatial crop suitability model' for the purpose of this study as suggested by Dent and Young (1981).

With the help of ID numbers, each land mapping unit could be spatially located on the generated map and the characters studied. More effectively it could be located and studied using a computer system with GIS capabilities as envisaged in the KISSAN (Kissan Information Systems, Services And Networking – Kerala) project presently launched by the Department of Agriculture, Government of Kerala. Using this data base a crop management expert could easily take right decision on location specific crop suitability of each land mapping unit.

In this study an attempt was also made by the researcher with his knowledge and experience on crop management to fix up the major crop suitability for each land mapping unit of the watershed by logically matching the biophysical factors of each land mapping unit with that of requirements of individual crops as furnished in Appendix VII. In this effort, out of the thirteen biophysical factors, two factors, namely average rainfall and mean temperature was considered as uniform for the watershed area on the basis of the secondary available data. Hence the variation in status of the remaining biophysical factors was the criterion taken into consideration for deciding the crop suitability for each land mapping unit (LMU).

3.7.8.2 Integration of socio-economic factors

The crop suitability of the study area was modified and finalised with respect to the six socio-economic factors through the process of participatory approach. The procedure followed was as detailed below.

Initially a list of crops which could be considered as the main crop for the study area was prepared by the researcher. From the list of progressive farmers available with the Krishi Bhavans, thirty farmers were randomly selected as respondents for this component of study. Then each crop was evaluated for its suitability as a main crop for the area with respect to the selected socio-economic factors. This was done using a three level rating namely S1 (>80%), S2 (40-80%) and S3 (<40%) as opined by the selected respondents. This process of participatory land evaluation of socio-economic factors was carried out through interview of the respondents with the help of a proforma furnished as Appendix VIII.

Then the percentage of respondents in each category of S1, S2 and S3 was calculated. This data was further processed into a two category data base as suitable and not suitable denoted by 'S' and 'N'. The data under category 'S' comprised of the combined percentage of S1 and S2 and the category 'N' consisted of the percentage value of S3. This was in line with the FAO factor rating method explained under Table 5, which states that an yield reduction upto to 40% might be acceptable to a subsistence farmer.

The suitability of each crop was assessed on the basis of the values under 'S' and 'N'. In this process of evaluation all the six factors were considered as equally important. Hence to consider a crop as suitable, the percentage value of all the six factors under 'S' category must be greater than or equal to 50. If not that particular crop was considered as unsuitable in the context of sustainable agriculture development.

On the basis of this information, the final crop suitability data base was generated for the area. In this process, the crop suitability fixed for each land mapping unit generated through the integration of biophysical factors was confirmed or modified and the crop suitability for each land mapping unit on micro watershed level for the study area was finalised.

3.8 PERCEPTION OF FARMERS ON THE UTILITY OF SPATIAL CROP SUITABILITY MODEL FOR SUSTAINABLE AGRICULTURE

The objective of assessing the utility of spatial crop suitability model for sustainable agriculture was envisaged in this study by assessing its likely utility as perceived by the farmers of the study area who are the actual beneficiaries.

The technique of focus group interview was used for the purpose. The thirty respondents for the evaluation of socio-economic factors under item 3.7.8.2 of the report, formed the respondents of this component of study also. The responses were collected through three group interviews as suggested by Morgan (1988). Details are given in the Table 6.

Table 6. Details of focus group interviews

Group No.	Location	Number of participants
I	Maranalloor	12
II	Razalpuram	8
III	Perumpazhuthur	10

The developed crop suitability model (crop suitability map with tabular details) with necessary introduction was presented to the groups by the researcher. Through interviews, the feed back of the respondents were collected using an unstructured, open-ended questionnaire to answer from a variety of dimensions as suggested by Kreuger (1988). Salient views of the individuals in the groups were recorded by the researcher. The questionnaire used is given in Appendix IX.

The next step was to analyse the raw data collected during the focus group interviews. The analysis was carried out in line with the recommendations of Kreuger (1988). Here an analysis of the content of the discussion was made. The aim of this analysis was to look into the trends and patterns that reappear within a single group or among different focus groups. Here the emphasis or intensity of the comments were also considered. The likely utility of the developed spatial crop suitability model for land evaluation as perceived by the farmers was assessed through qualitative research on the basis of these interviews and the salient opinions of the respondents were summerised and documented for the purpose of this study.

3.9 PROCEDURE EMPLOYED IN DATA COLLECTION

The study required collection of secondary data (both spatial and non-spatial), generation of primary spatial data on biophysical factors using secondary data, remote sensing data and ground truth and also assessing the responses of the respondents at various stages of the study.

3.9.1 Secondary data

a) Spatial

Soil information	-	large scale soil maps with reports from State Soil Survey Organization

b) Non-spatial

i) Ground water information	-	State Ground Water Department
ii) Meterological data	-	Rainfall and Temperature data of Chittar basin from C.W.R.D.M. sub centre, Neyyattinkara

iii) Soil test data Data on crops Information on markets Details of farmers	From Krishi Bhavans of Perumpazhuthur,Maranalloor and Kattakada

3.9.2 Data base used for generation of primary spatial data

i) Survey of India Topomaps : Nos. 58H/3/NW & 58 H/2/SW with KSLUB

ii) Remote sensing data :

a) Aerial photographs : 1:15000 scale Black and White photographs available with KSLUB.

b) Satellite data : 1:50000 FCC IRS-IC (LISS III) data available with KSLUB

iii) Watershed Atlas : 1:50,000 atlas of Neyyar Watershed of KSLUB

3.9.3 Responses from respondents

i) Judges' rating - responses collected from the selected judges on factors of land evaluation through mail or in person during April/May/June 2003 using Pusa rank sheet for Q-sort.

ii) Response of Agricultural Officers - Data were collected using a well constructed and structured questionnaire during June / July / August 2003 through mail from Agricultural Officers working in Thiruvananthapuram district.

iii) Response of farmers - a) The evaluation and rating of socio-economic factors for land evaluation was carried out using interview schedule from 30 progressive farmers of the study area

b) The perception on likely utility of the spatial crop suitability model was assessed through focus group interviews using unstructured open - ended questionnaire from 30 progressive farmers of the study area.

3.10 STATISTICAL TOOLS USED IN THE STUDY

The statistical tools used in analyzing the data collected for the study were mean, standard deviation, percentage analysis and correlation analysis.

RESULTS AND DISCUSSION

4. RESULTS AND DISCUSSION

The findings of the study along with the discussion are presented in this chapter under the following headings.

4.1. Factors of participatory and integrated land evaluation for crop suitability for sustainable agriculture

4.2. Distribution of Agricultural Officers based on their profile characteristics

4.3. Awareness of Agricultural Officers on land evaluation for sustainable agriculture

4.4. Knowledge of Agricultural Officers on land evaluation for sustainable agriculture

4.5. Attitude of Agricultural Officers on land evaluation for crop suitability

4.6. Relationship between the dependent and independent variables

4.7. Development of spatial crop suitability model at micro watershed level through participatory and integrated land evaluation for sustainable agriculture

4.8. Perception of farmers on the likely utility of the spatial crop suitability model for sustainable agriculture

4.1 FACTORS OF PARTICIPATORY AND INTEGRATED LAND EVALUATION FOR CROP SUITABILITY FOR SUSTAINABLE AGRICULTURE

The results with relevant discussion are presented below. Selection of most important factors involved two steps.

4.1.1 Correlation among judges

The correlation among the thirty judges in rating the eighty factors was studied using the correlation matrix given as Table 7. It was found from the table that twenty nine judges except judge number three had significant correlation at 0.01 level with atleast one of the other twenty eight judges. Judge number three was not having correlation with any of the other twenty nine judges. Hence only the rank sheet received from twenty nine judges, except that of judge No. 3 was used in the process of final selection of the most important factors.

4.1.2 Final selection of the most important factors

The most important or the critical biophysical and socio-economic factors for participatory and integrated land evaluation for crop suitability aimed at sustainable agriculture was identified on the basis of the weightage scores. Out of the eighty factors originally given for Pusa rank sheet rating by the judges, it was found that only sixty four factors fell in any of the first three piles of atleast one of the selected twenty nine judges (Appendix X). Remaining sixteen factors were not considered as most important factors by any of the judges and hence none of them had put these factors in any of the first three piles of their rank sheet.

The sixty four factors on the basis of their weightage scores are presented in descending order in Table 8.

Table 7. Correlation among the judges in Pusa Q-sort ranking of factors for land evaluation

Code*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1.000														
2	0.164	1.000													
3	0.021	0.285	1.000												
4	0.126	0.456	0.141	1.000											
5	0.077	0.194	0.148	0.310	1.000										
6	0.009	0.198	0.042	0.348	0.521	1.000									
7	0.262	0.324	0.043	0.495	0.279	0.181	1.000								
8	0.009	0.441	0.046	0.826	0.366	0.324	0.385	1.000							
9	0.061	0.183	0.191	0.160	0.726	0.286	0.150	0.402	1.000						
10	0.108	0.438	0.092	0.512	0.449	0.440	0.391	0.647	0.488	1.000					
11	0.085	0.486	0.109	0.637	0.304	0.337	0.486	0.619	0.291	0.644	1.000				
12	0.051	0.288	-0.071	0.587	0.246	0.353	0.492	0.524	0.130	0.500	0.571	1.000			
13	0.022	0.497	0.138	0.587	0.517	0.468	0.422	0.650	0.460	0.750	0.639	0.533	1.000		
14	0.084	0.459	0.193	0.455	0.336	0.274	0.367	0.467	0.298	0.569	0.610	0.491	0.763	1.000	
15	0.009	0.307	-0.067	0.407	0.428	0.348	0.340	0.362	0.332	0.506	0.482	0.503	0.587	0.458	1.000
16	-0.109	0.401	0.102	0.515	0.469	0.382	0.474	0.676	0.543	0.749	0.763	0.448	0.721	0.567	0.464
17	-0.105	0.388	0.070	0.489	0.443	0.294	0.406	0.666	0.538	0.696	0.648	0.380	0.670	0.492	0.396
18	0.093	0.501	0.134	0.536	0.451	0.455	0.382	0.668	0.482	0.943	0.637	0.533	0.753	0.584	0.539
19	-0.069	0.206	-0.098	0.045	0.446	0.398	0.075	0.252	0.553	0.431	0.323	0.220	0.405	0.390	0.326
20	-0.103	0.400	0.069	0.481	0.463	0.347	0.458	0.654	0.521	0.725	0.687	0.401	0.670	0.490	0.399
21	0.089	0.435	0.069	0.567	0.370	0.425	0.506	0.668	0.415	0.866	0.674	0.535	0.715	0.579	0.449
22	-0.132	0.140	-0.147	0.009	0.398	0.351	0.066	0.207	0.522	0.386	0.302	0.211	0.326	0.296	0.320
23	0.072	0.451	0.095	0.504	0.476	0.458	0.380	0.660	0.507	0.969	0.635	0.468	0.754	0.543	0.510
24	0.082	0.371	0.074	0.452	0.466	0.316	0.399	0.603	0.512	0.712	0.640	0.332	0.683	0.497	0.373
25	0.094	0.403	0.051	0.563	0.359	0.434	0.479	0.660	0.436	0.857	0.642	0.514	0.720	0.537	0.458
26	0.057	0.432	0.125	0.548	0.475	0.470	0.498	0.629	0.436	0.916	0.619	0.557	0.775	0.572	0.548
27	0.069	0.457	0.174	0.590	0.391	0.441	0.418	0.653	0.358	0.885	0.607	0.504	0.709	0.549	0.483
28	0.090	0.170	0.055	0.338	0.578	0.838	0.259	0.377	0.396	0.533	0.320	0.343	0.537	0.365	0.368
29	0.886	0.173	-0.021	0.102	0.089	-0.012	0.292	0.012	0.080	0.150	-0.024	0.118	0.057	0.117	0.099
30	0.120	0.414	0.027	0.574	0.430	0.457	0.509	0.660	0.457	0.852	0.673	0.514	0.746	0.560	0.451

(Table 7.Contd...)

Code	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
16	1.000														
17	0.944	1.000													
18	0.746	0.702	1.000												
19	0.409	0.306	0.425	1.000											
20	0.941	0.943	0.728	0.367	1.000										
21	0.742	0.689	0.848	0.417	0.730	1.000									
22	0.367	0.249	0.395	0.952	0.323	0.384	1.000								
23	0.750	0.712	0.939	0.426	0.732	0.849	0.381	1.000							
24	0.908	0.926	0.700	0.318	0.936	0.679	0.270	0.713	1.000						
25	0.737	0.679	0.850	0.355	0.721	0.938	0.349	0.840	0.668	1.000					
26	0.743	0.699	0.604	0.392	0.722	0.878	0.362	0.927	0.688	0.854	1.000				
27	0.658	0.597	0.909	0.391	0.622	0.800	0.352	0.890	0.598	0.794	0.876	1.000			
28	0.449	0.396	0.506	0.512	0.425	0.488	0.437	0.537	0.397	0.475	0.560	0.504	1.000		
29	-0.036	-0.036	0.123	-0.075	-0.044	0.100	-0.132	0.126	-0.030	0.094	0.108	0.095	0.078	1.000	
30	0.729	0.677	0.837	0.356	0.730	0.935	0.334	0.841	0.680	0.690	0.855	0.789	0.472	0.126	1.000

$r \geq 0.287$ at 0.01 level * Code number of judges

Table 8. Biophysical and socio-economic factors for participatory and integrated land evaluation for sustainable agriculture with corresponding ranks and weightage scores

Rank Order	Item description	*Weightage Score
1	Slope	63
2	Rainfall	62
3	Physiography	60
4	Soil depth	60
5	Soil texture	48
6	Soil drainage	42
7	Soil erosion	34
8	Temperature	30
9	Economic viability	29
10	Elevation	28
11	Presence of rocks/gravels/stones	27
12	Economic feasibility	27
13	Infra-structural facilities	27
14	Market demand	26
15	Social acceptability	25
16	Soil pH	24
17	Ground water	24
18	Major nutrients	20
19	Farming experience	15
20	Soil organic matter	14
21	Relative humidity	14
22	Market access	13
23	Increase in productivity	12
24	Employment generation	12
25	Surface water	12
26	Rainfall distribution	11
27	Environment soundness	11
28	Soil moisture	10
29	Cation exchange capacity (CEC)	10
30	Landuse / Land cover	10

(Table 8 Contd...)

Rank Order	Item description	Weightage Score
31	Sustained profit	10
32	Soil salinity	9
33	Local adaptability	9
34	Average size of holdings	9
35	Resource use efficiency	9
36	Capacity building	7
37	Management orientation	7
38	Guidance and supervision	6
39	Self sufficiency	6
40	Major occupation	6
41	Initiative	6
42	Self reliance	5
43	Soil temperature	5
44	Entrepreneurial behaviour	5
45	Indeptedness	5
46	Soil structure	4
47	Solar radiation	4
48	Temporal stability	4
49	Labour need	4
50	Economic motivation	3
51	Soil mineral matter	3
52	Cropping intensity	3
53	Group cohesion	3
54	Technical competency	2
55	Innovativeness	2
56	Crop appropriability	2
57	Orientation towards incentives	2
58	Soil colour	1
59	Credit orientation	1
60	Involvement in decision making	1
61	Evapo-transpiration	1
62	Wind velocity	1
63	Participation in PTD	1
64	Canopy density	1

* Maximum possible weightage score for an item is 87

Table 9. Most important biophysical and socio-economic factors for participatory and integrated land evaluation for sustainable agriculture

Sl. No.	Biophysical factors	Sl. No.	Socio-economic factors
1	Slope	1	Economic viability
2	Rainfall	2	Economic feasibility
3	Physiography	3	Infra-structural facilities
4	Soil depth	4	Market demand
5	Soil texture	5	Social acceptability
6	Soil drainage	6	Farming experience
7	Soil erosion		
8	Temperature		
9	Elevation		
10	Presence of rocks/gravels/stones		
11	Soil pH		
12	Groundwater		
13	Major nutrients		

The Table 8 revealed that the factor namely 'slope' with maximum weightage score of 63 ranked first. This was followed by rainfall, physiography, soil depth, soil texture etc. It can be noted from the table that the least score of '1' was obtained by seven factors namely soil colour, credit orientation, involvement in decision making, evapotranspiration, wind velocity, participation in PTD and canopy density.

As per the Pusa rank sheet for Q-sort the first nineteen factors were obtained as the most important factors. Hence in this study also the nineteen factors with the highest weightage scores as shown in the Table 8 was considered as the most important or the critical factors for participatory and integrated land evaluation in this study. These nineteen factors were grouped as thirteen biophysical and six socio-economic factors as shown in the Table 9.

4.2 DISTRIBUTION OF AGRICULTURAL OFFICERS BASED ON THEIR PROFILE CHARACTERISTICS

The distribution of the Agricultural Officers on the basis of their profile characteristics is given in Table 10 and its graphical representation is given as Fig. 4.

The respondents were grouped into low and high categories with respect to all the profile characteristics except sex on the basis of mean values. With regard to sex, the respondents were grouped as male and female on the basis of the respective score values.

Table 10. Distribution of the respondents (Agricultural Officers) based on their profile characteristics

(n=100)

Sl. No.	Characteristics	Category	Score	Frequency	Percentage
1	Sex	Male	1	55	55
		Female	2	45	45
2	Age	Low	< 39.28	58	58
		High	≥ 39.28	42	42
3	Educational status	Low	< 2.18	67	67
		High	≥ 2.18	33	33
4	Rural/Urban background	Low	< 2.19	46	46
		High	≥ 2.19	54	54
5	Training received	Low	< 4.76	74	74
		High	≤ 4.76	26	26
6	Job experience	Low	< 13.93	50	50
		High	≥ 13.93	50	50
7	Cosmopoliteness	Low	< 6.79	38	38
		High	≥ 6.79	62	62
8	Exposure to Internet/IT	Low	< 1.03	82	82
		High	≥ 1.03	18	18
9	Entrepreneurial behaviour	Low	< 17.41	45	45
		High	≤ 17.41	55	55
10	Innovation proness	Low	< 4.37	45	45
		High	≥ 4.37	55	55
11	Self confidence	Low	< 28.81	42	42
		High	≥ 28.81	58	58
12	Scientific orientation	Low	< 23.58	50	50
		High	≥ 23.58	50	50
13	Achievement motivation	Low	< 21.51	53	53
		High	≥ 21.51	47	47
14	Attitude towards profession	Low	< 41.16	42	42
		High	≥ 41.16	58	58
15	Job satisfaction	Low	< 30.89	40	40
		High	≤ 30.89	60	60
16	Job involvement	Low	< 42.57	48	48
		High	≥ 42.57	52	52
17	Organizational climate	Low	< 13.59	45	45
		High	≥ 13.59	55	55

It is evident from Table 10 and Fig. 4 that the respondents comprised of 55 per cent male and 45 per cent female. With respect to the other profile characteristics namely age, educational status, training received, exposure to Internet/IT and achievement motivation, the percentage of low group respondents were more. Among these the maximum percentage (82 %) in low group was with respect to the exposure to Internet/IT followed by training received (74 %) and educational status (67 %).

With respect to the profile characteristics such as rural/urban background, cosmopoliteness, entrepreneurial behaviour, innovation proness, self confidence, attitude towards profession, job satisfaction, job involvement and organizational climate, the maximum percentage of respondents were in high group category. The maximum number of respondents in the high group was observed for the profile characteristic cosmopoliteness (62 %) followed by job satisfaction (60 %), attitude towards profession and self confidence with 58 per cent each.

The profile characteristics job experience and scientific orientation had equal number (50 %) of respondents in low and high groups.

The study revealed that the exposure of respondents to Internet/IT was very low. Similarly the variable training received by them was also not upto the desired level. It was felt that these problems could be solved by strengthening the HRD wing of Department of Agriculture. By improving these two profile characteristics, the respondents can be exposed to the latest advancements in the field of sustainable agriculture development. Land evaluation for crop suitability must form a major thrust area in HRD for agriculture development. With regard to educational status, the respondents of low group possessed either diploma or under-graduate degree in agriculture and the high group possessed either post-graduation or Ph.D. in Agricultural Science.

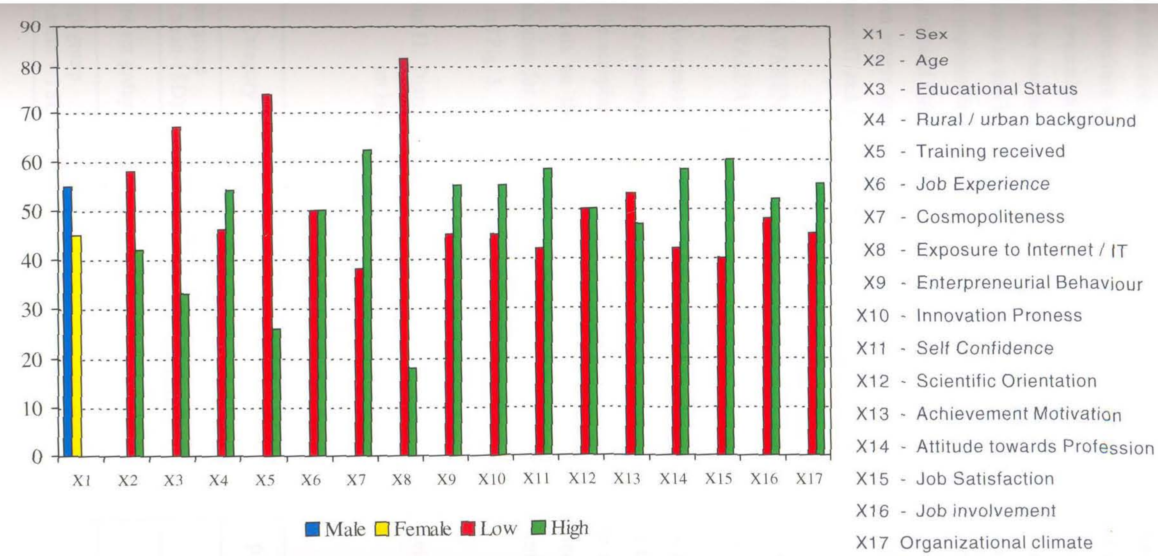

Fig. 4. Distribution of the respondents based to their profile characteristics (independent variables)

The study revealed that the Agricultural Officers of the State Department of Agriculture are not presently applying the FAO method of scientific land evaluation in recommending crop suitability to the farmers. This might be due to their low exposure to Internet/IT and also lack of proper training to use this technique. Land evaluation being a major component for implementing sustainable agriculture development schemes, the Agricultural Officers who are the prime users of this technology must be given proper exposure on land evaluation for crop suitability through Internet/IT and training facilities.

4.3 AWARENESS OF AGRICULTURAL OFFICERS ON LAND EVALUATION FOR SUSTAINABLE AGRICULTURE

Awareness of a technology or a programme among its stakeholders is a pre-requisite for its successful implementation. This is the first step for the acceptance of a programme or a technology by the stakeholder. The data on the level of awareness of Agricultural Officers on land evaluation for sustainable agriculture development is presented in Table 11 and Fig. 5.

Table 11. Distribution of the respondents according to their awareness on land evaluation for sustainable agriculture

(n=100)

Category	Score	Frequency	Percentage
Low group (< mean-1SD)	< 7.42	16	16
Medium group	7.42 – 11.16	75	75
High group (> mean + 1SD)	> 11.16	9	9

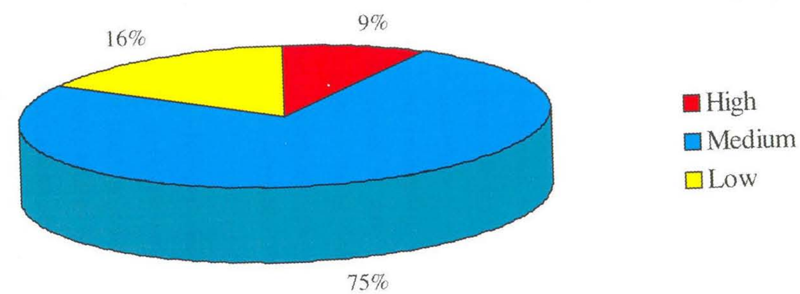

Fig. 5. Distribution of the respondents according to their awareness about land evaluation for sustainable agriculture development

The study indicated how much the Agricultural Officers were familiar with the basic concepts and principles of land evaluation. In case of the respondents of this study, it was found that 75 per cent of them belonged to medium category with respect to their awareness on land evaluation for sustainable agriculture. This was followed by low category with 16 per cent and high category with only 9 per cent.

In the present context of sustainable agriculture development, land evaluation for crop suitability deserved top priority. It helped in the optimum use of the available land resources to maximise crop production on a sustainable basis. Hence the Agricultural Officers who are the prime stakeholders of land evaluation and also as the technocrats to advice the farmers in proper crop selection, they must be well aware on the basic concept, principles and types of land evaluation. It is evident from the study that among the respondents with respect to awareness level, the high category consisted of only 9 per cent while the low category consisted of 16 per cent. From such a result it is evident that the exposure of Agricultural Officers towards the basic concept and principles of land evaluation is very limited.

It is felt that for the effective application of the technique of land evaluation for agricultural development activities by the State Department of Agriculture, at least majority of grass root level officers namely the Agricultural Officers has to fall in the high category level with respect to their awareness on land evaluation.

4.4 KNOWLEDGE OF AGRICULTURAL OFFICERS ON LAND EVALUATION FOR SUSTAINABLE AGRICULTURE

Knowledge level indicated the know how the Agricultural Officers had with respect to the scientific principles and techniques involved in carrying out land evaluation for sustainable agriculture development. The results are presented in the Table 12 and is diagrammatically presented as Fig. 6.

Table 12. Distribution of the respondents according to their knowledge on land evaluation for sustainable agriculture development

(n=100)

Category	Score	Frequency	Percentage
Low group (< mean – 1SD)	< 25.46	19	19
Medium group	25.46 – 54.38	72	72
High group (> mean + 1SD)	> 54.38	9	9

The study revealed that 72 per cent of the respondents belonged to medium group followed by low group and high group with 19 per cent and 9 per cent respectively with respect to their knowledge on land evaluation for sustainable agriculture. In this context it was found that the knowledge of the respondents were not upto the required level. These respondents are the technocrats at the grass root level to advice the farmers on crop selection and management. It was found that the high group category of respondents consisted of only 9 per cent while a significant percentage (19 %) fell in low group with respect to the knowledge level. This must be the main reason for the non-adoption of proper land evaluation procedures by the Agricultural Officers in giving appropriate crop recommendation to the farmers on the basis of the available land resources.

The Agricultural Officers must have a sound knowledge on FAO land evaluation procedures for crop suitability to achieve sustainable

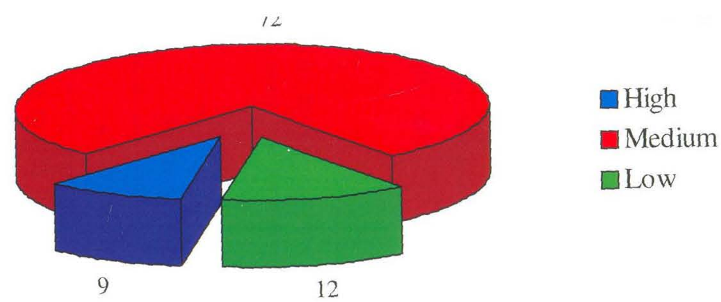

Fig. 6. Distribution of the respondents according to their knowlede on land evaluation for sustainable agriculture development

agriculture in the State. To achieve this objective, atleast majority of Agricultural Officers must fall in high category with respect to their knowledge on land evaluation. This finding highlighted the need for providing sufficient training to the respondents on land evaluation. For the purpose, the HRD wing of the Department of Agriculture must be strengthened with emphasis on land evaluation procedures which is a pre-requisite to achieve sustainability in agriculture.

4.5 ATTITUDE OF AGRICULTURAL OFFICERS ON LAND EVALUATION FOR CROP SUITABILITY

The distribution of respondents on the basis of their attitude towards land evaluation for crop suitability is presented in Table 13 and the same is diagramatically represented as Fig. 7.

Table 13. Distribution of the respondents according to their attitude towards land evaluation for crop suitability

(n=100)

Category	Score	Frequency	Percentage
Unfavourable (< mean – 1SD)	< 45.83	15	15
Favourable	45.83 – 59.19	70	70
Highly favourable (> mean + 1SD)	> 59.19	15	15

Favourable attitude towards any development programme is a prime requirement for its acceptance and increased participation. The Table 13 revealed that 70 per cent of Agricultural Officers belonged to the

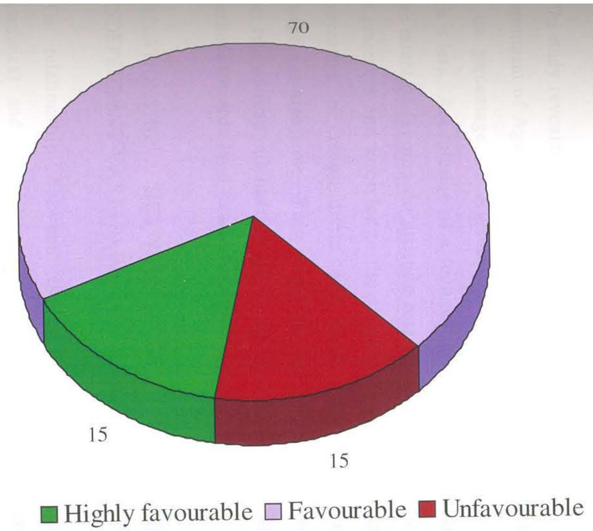

Fig. 7. Distribution of the respondents according to their attitude towards land evaluation for crop suitability

favourable group with respect to their attitude towards land evaluation for crop suitability. The unfavourable and highly favourable groups constituted 15 per cent each. The Agricultural Officers are the prime stakeholder of the technology of land evaluation in recommending to the farmers on crop suitability for sustainable agriculture. For the proper acceptance of this technology, majority of Agricultural Officers must possess high favourable attitude towards this technology.

The study revealed that this technology is not properly adopted by the Department of Agriculture at present. One of the important reasons being the percentage of Agricultural Officers with high favourable attitude is less. Acceptance of a technology by its stakeholders depends on their extent of favourable attitude towards it. This in turn is related to the awareness and knowledge the stakeholder possess. In this study the percentage of respondents with high level of awareness and knowledge was also low. This might be one of the major reasons with low per cent of respondents falling in the high category with respect to their attitude towards land evaluation for crop suitability.

4.6 RELATIONSHIP BETWEEN THE DEPENDENT AND INDEPENDENT VARIABLES

The relationship between the different independent (profile characteristics) and dependent variables (awareness, knowledge and attitude) of this study are presented under this section.

4.6.1 Correlation analysis between profile characteristics and awareness

Results of the correlation analysis between the profile characteristics and awareness are presented in the Table 14 below.

Table 14. Correlation analysis of awareness on land evaluation with profile characteristics

(n=100)

Sl. No.	Independent variables	Correlation coefficient (r)
1	Sex	0.183
2	Age	0.088
3	Educational status	0.069
4	Rural/urban background	0.165
5	Training received	-0.033
6	Job experience	0.131
7	Cosmopoliteness	0.063
8	Exposure to Internet/IT	0.131
9	Entrepreneurial behaviour	0.119
10	Innovation proness	-0.016
11	Self confidence	0.172
12	Scientific orientation	-0.004
13	Achievement motivation	-0.309**
14	Attitude towards profession	0.101
15	Job satisfaction	0.060
16	Job involvement	0.224**
17	Organizational climate	0.122

** Significant at 1 per cent level

The above table revealed that out of the 17 profile characteristics, only one variable, namely job involvement had significant positive relationship with the dependent variable awareness of Agricultural Offices towards land evaluation for sustainable agriculture. Hence it can be concluded that more job involvement leads to better awareness of the respondents on land evaluation for sustainable agriculture.

4.6.2 Correlation analysis between profile characteristics and knowledge

Results of the correlation analysis between profile characteristics and knowledge are presented in the Table 15 below.

Table 15. Correlation analysis of knowledge on land evaluation with profile characteristics

(n=100)

Sl. No.	Independent variables	Correlation coefficient (r)
1	Sex	0.112
2	Age	-0.304**
3	Educational status	0.371**
4	Rural/urban background	-0.205*
5	Training received	-0.413**
6	Job experience	-0.291**
7	Cosmopoliteness	0.008
8	Exposure to Internet/IT	0.051
9	Entrepreneurial behaviour	-0.088
10	Innovation proness	0.005
11	Self confidence	0.160
12	Scientific orientation	-0.037
13	Achievement motivation	-0.003
14	Attitude towards profession	0.344**
15	Job satisfaction	-0.191
16	Job involvement	0.142
17	Organizational climate	-0.087

* Significant at 5 per cent level   ** Significant at 1 per cent level

As revealed by Table 15, out of 17 profile characteristics, six variables namely age, educational status, rural/urban background, training received, job experience and attitude towards profession had significant relationship with the dependent variable namely knowledge of Agricultural Officers towards land evaluation. Out of these, two variables namely educational status and attitude towards profession had positive relationship while the other four had negative relationship with the knowledge. The remaining eleven variables showed no significant relationship with the knowledge. Hence it can be concluded that the educational status and attitude towards profession helped in improving the knowledge level of Agricultural officers on land evaluation for sustainable agriculture development.

4.6.3 Correlation analysis between profile characteristics and attitude

Results of the correlation analysis between profile characteristics and attitude are presented in Table 16 below.

Table 16. Correlation analysis of attitude towards land evaluation with profile characteristics

(n=100)

Sl. No.	Independent variables	Correlation coefficient (r)
1	Sex	-0.087
2	Age	-0.100
3	Educational status	0.199*
4	Rural/urban background	-0.243**
5	Training received	-0.143
6	Job experience	-0.061
7	Cosmopoliteness	-0.144
8	Exposure to Internet/IT	0.329**
9	Entrepreneurial behaviour	0.201*
10	Innovation proness	0.185
11	Self confidence	0.286**
12	Scientific orientation	0.244**
13	Achievement motivation	0.056
14	Attitude towards profession	0.281**
15	Job satisfaction	0.096
16	Job involvement	0.230**
17	Organizational climate	0.083

* Significant at 5 per cent level ** Significant at 1 per cent level

The Table 16 revealed that out of the 17 profile characteristics, eight variables namely educational status, rural/urban background, exposure to Internet/IT, entrepreneurial behaviour, self confidence, scientific orientation, attitude towards profession and job involvement had significant relationship with the attitude of Agricultural Officers towards land evaluation for crop suitability. Among the eight, while the variable rural/urban background had negative relation, all the other seven variables had positive relationship. Hence it can be concluded that these eight variables influenced the attitude of Agricultural Officers towards land evaluation for crop suitability in the context of sustainable agriculture development process.

4.6.4 Inter correlation between the dependent variables

The results of the inter correlation analysis between awareness, knowledge and attitude of Agricultural Officers towards land evaluation for sustainable agriculture development are presented in the Table 17.

Table 17. Inter correlation analysis between awareness, knowledge and attitude

(n=100)

Variables	Awareness	Knowledge	Attitude
Awareness	1.000	-	-
Knowledge	0.197*	1.000	-
Attitude	0.335**	0.280**	1.000

* Significant at 5 per cent level ** Significant at 1 per cent level

Results of Table 17 revealed that there existed positive and significant relationship between the three dependent variables namely awareness, knowledge and attitude. Hence it can be concluded that an increase in the level of one variable will have positive and significant influence on the other two.

4.7 DEVELOPMENT OF SPATIAL CROP SUITABILITY MODEL AT MICRO WATERSHED LEVEL THROUGH PARTICIPATORY AND INTEGRATED LAND EVALUATION FOR SUSTAINABLE AGRICULTURE

This section deals mainly with the secondary spatial data/primary spatial data on most important biophysical factors of land evaluation, integration of biophysical and socio-economic factors for spatial crop suitability model, effectiveness of remote sensing technology for resource analysis etc. The data are presented as non-spatial and spatial information along with relevant discussion. For convenience of the report, the spatial data (maps) are presented in reduced scale (1:60,000) and not in the original scale of the study namely 1:10,000.

4.7.1 Agro-ecological situations of the study area

As presented in Table 18 and Fig. 8, the study area was divided into four agro-ecological situations. They are mid land wet condition (MLW), mid land dry condition (MLD), mid land dry situation - red loam soil (RLS) and homestead farming situation (HF).

Table 18. Agro-ecological situations of Aruvipuram watershed

Sl. No.	Agro-ecological situations	Area (Ha)	Percentage of total area
1	Mid land wet condition (MLW)	831.75	26.76
2	Mid land dry condition (MLD)	315.96	10.16
3	Mid land dry situation – red loam soil (RLS)	709.57	22.82
4	Homestead farming situation (HF)	1251.84	40.26
Total		3109.12	100.00

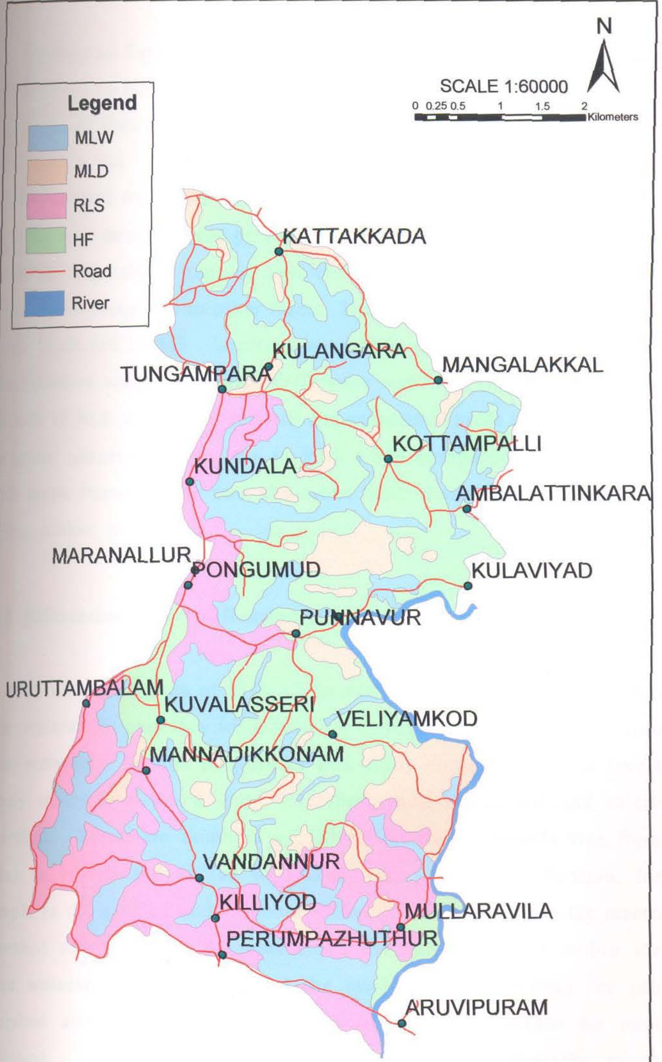

Fig.8 Base Map showing agro ecological situations of Aruvipuram watershed

The data in Table 18 revealed that more than 40 per cent of the area was occupied by HF. This is the typical Kerala situation which hosted a wide range of both perennial and seasonal crops. This was followed by MLW (26.76 %). Here compared to other three situations, the soil moisture content was more and substantial area had the benefit of Neyyar command area development project. Main crops found in this situation are paddy, vegetables, tapioca and coconut. It is located in a lower altitude when compared to other three. This was followed by RLS (22.82 %) and MLD (10.16 %). Location wise both are situated almost in the same elevation range. The main difference was with respect to the soil. The soils of RLS were more reddish and responded more to management. The gravel percentage was less in RLS when compared to MLD. The major crops found in the two situations were mainly coconut, banana, tapioca, rubber, pepper etc.

4.7.2 Delineation and codification of micro watersheds

The watershed area of 3109.12 hectares was delineated into fifteen micro watersheds and they were suitably codified. The codification upto micro watershed for the purpose of this study consisted of four levels namely macro watershed, sub watershed, mini watershed and micro watershed. The code numbers of fifteen micro watersheds was from 1N6a1 to 1N6a6 and 1N7a1 to 1N7a9. As per the codification, for example in the case of code number 1N6a1. '1N' represented the macro watershed of 'Neyyar', '6' represented the sub watershed within the macro watershed, 'a' represented the mini watershed within the sub watershed and '1' represented the micro watershed within the mini watershed. This was the case with the remaining fourteen micro watershed also. The delineated and codified micro watersheds are presented as Fig. 9.

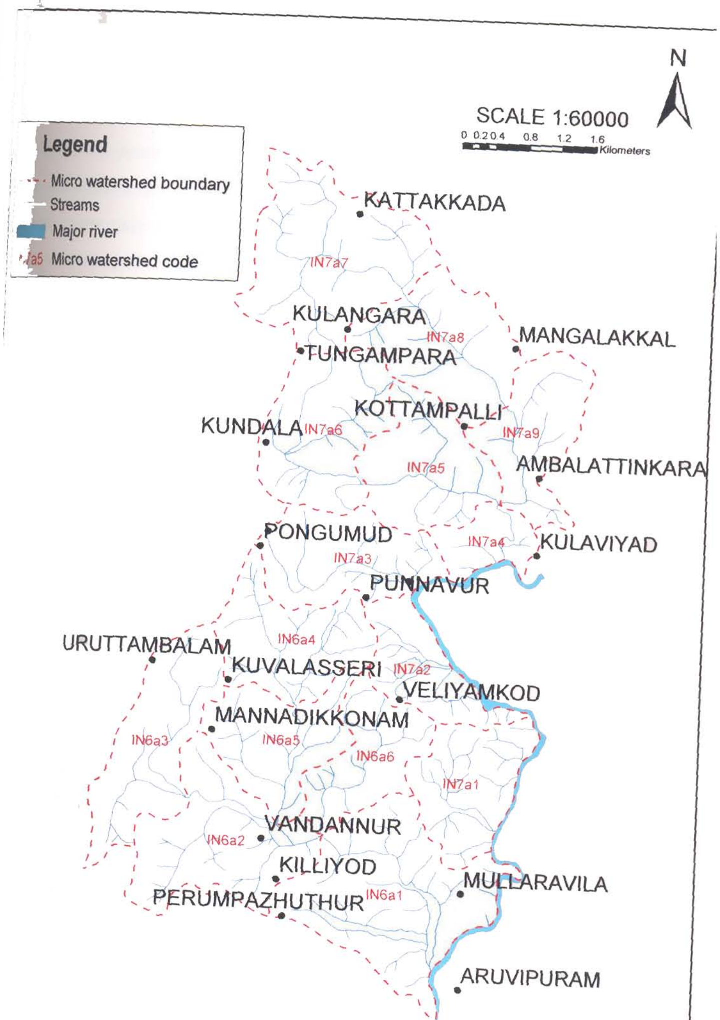

Fig.9 Micro watersheds of Aruvipuram watershed with boundaries and codification

4.7.3 Characteristics of the micro watersheds

The data pertaining to different characteristics of the fifteen micro watersheds are presented in Table 19. As revealed by the table the area of micro watersheds ranged from 361.04 hectares in the case of 1N6a1 to 76.07 hectares in the case of 1N7a4. The shape varied from square to feather. The micro watersheds hosted a wide range of crops. The dominant crops being coconut, banana, tapioca and rubber. The general soil erosion status of the micro watershed varied from moderate (e2) to severe (e3).

Table 19. Characteristics of the micro watersheds

No	Water-shed code	Area (Ha)	Shape	*Major crops grown	**Soil erosion status	Drainage pattern
1	1N6a1	361.04	Fan	Co,Tp,Ba,Pd	e2	Rectangular
2	1N6a2	257.20	Rectangular	Co,Tp,Ba,Ru	e2	Rectangular
3	1N6a3	228.08	Feather	Co,Tp,Ba,Ru,Cw,Mt	e2	Rectangular
4	1N6a4	195.65	Rectangular	Co,Ba,Tp,Mt	e2	Dentritic
5	1N6a5	181.78	Rectangular	Co,Ba,Ru,Tp,Mc	e2	Dentritic
6	1N6a6	151.63	Rectangular	Co,Ba,Tp,Mc	e2	Rectangular
7	1N7a1	177.50	Square	Ru,Co,Tp,Mc	e3	Dentritic
8	1N7a2	134.43	Rectangular	Ru,Co,Mc	e3	Dentritic
9	1N7a3	196.83	Rectangular	Co,Ba,Ru,Mc	e2	Rectangular
10	1N7a4	76.07	Square	Ru,Co,TP,Ba,Mc	e3	Rectangular
11	1N7a5	195.45	Squre	Co,Ba,TP,Ru,Mc	e3	Rectangular
12	1N7a6	228.10	Rectangular	Co,Tp,Ba,Mc	e2	Rectangular
13	1N7a7	332.02	Square	Co,Ba,Tp,Mc	e2	Rectangular
14	1N7a8	222.04	Rectangular	Co,Ru,Ba,Tp	e2	Rectangular
15	1N7a9	171.30	Square	Co,Tp,Ru,Ba,Mc	e2	Rectangular
	Total	3109.12				

* Co - Coconut Tp - Tapioca Ba - Banana Pd - Paddy
Ru - Rubber Cw - Cashew Mt - Mixed trees Mc - Mixed crops
** e2 - Moderate e3 - Severe

The physical shape of watershed is usually expressed as circular, square, rectangle and fan. This provides certain clues about the hydrology and erodibility. With respect to the shape, it was noted that none of the micro watersheds had circular shape. From the point of view of erodability, usually circular shaped watersheds experience maximum sediment transport followed by square, rectangular, fan and feather shapes. With respect to the crops grown, except micro watershed 1N7a1, 1N7a2 and 1N7a4, the major percentage of the area was under coconut and in the case of above mentioned three micro watersheds, the predominant crop was rubber. The other crops were banana, tapioca, mixed crops and a small area under paddy cultivation. It was evident from the study that nearly 98 per cent of the paddy fields were converted for other uses. As seen from the table majority (11 numbers) of the micro watersheds had the erosion status as e2 which meant it was moderate and the remaining ones had e3 ie., severe erosion. Signs of very severe erosion was not noticed in the study area which was an indication that the management of the land resources was not poor. The drainage pattern or the drainage network of streams is the resultant of interaction of several factors such as time, slope, rock resistance, structure, geology and human intervention. The types of drainage patterns are dendritic, rectangular, trellised, parallel, radial, centripetal, annular and deranged. Only two types of drainage patterns existed for the study area namely dendritic and rectangular. In the case of dentritic pattern, the drainage network of streams will be similar to branches of tree, characterized by irregular branching in all directions and the tributaries will join the main stream at all angles. But in the case of rectangular, the main characteristic is the right angle bents in both the main stream and its tributaries. The proneness to erosion hazards generally will be more in dendritic than in rectangular. Out of the 15 micro watersheds, 11 had rectangular pattern which indicated that there was no risk of very severe erosion status in the study area.

4.7.4 Meterological Data

The important meterological data required for the purpose of this study were the mean atmospheric temperature and average annual rainfall. These two data representing the study area are furnished as Table 20 and Table 21 respectively.

As revealed by Table 20, the monthly average atmospheric temperature varied from 30°C to 33°C making the annual mean temperature to 31°C. This data gave the indication that the watershed area had a tropical climate.

Table 20. Atmospheric temperature data representing Aruvipuram watershed

Month	Maximum temperature (° C)									Mean
	1993	1994	1995	1996	1997	1998	1999	2000	2001	
Jan.	-	32	33	34	33	32	31	31	31	32
Feb.	-	33	34	34	34	33	32	31	29	33
Mar.	34	33	33	35	34	34	33	30	30	33
Apr.	34	33	32	33	34	34	31	31	-	33
May	34	33	31	34	33	32	29	32	-	32
Jun.	30	30	31	31	32	30	28	28	-	30
Jul.	29	30	31	30	31	29	29	29	-	30
Aug.	30	30	31	31	31	30	30	28	-	30
Sep.	32	31	32	31	31	30	32	30	-	31
Oct.	31	30	31	31	31	29	28	29	-	30
Nov.	30	31	32	31	29	31	31	29	-	31
Dec	31	33	34	31	31	29	30	29	-	31
Avg	**32**	**32**	**32**	**32**	**32**	**31**	**30**	**30**	**30**	**31**

Source : CWRDM Sub Centre, Neyyattinkara

Regarding rainfall as evident from Table 21, the rainfall was generally distributed throughout the year. The average annual rainfall based on the data Table 21 was found to be 2004 mm. According to mean values, maximum rainfall was received during the month of October. It also revealed that among the two monsoons, NE received more rainfall than the SW. It can be seen from the table that the maximum rainfall was received during the year 1998 and after that there was a declining trend. It can be concluded that the area enjoyed a humid tropical climate making the watershed area ideal for a wide range of tropical crops.

Table 21. Rainfall data representing Aruvipuram watershed area

Month	Monthly rainfall (mm)									Mean (mm)
	1992	1993	1994	1995	1996	1997	1998	1999	2000	
Jan.	-	0	3	82	35	2	0	4	14	17
Feb.	-	76	124	0	29	7	3	42	68	44
Mar.	-	14	22	73	3	48	0	15	28	25
Apr.	-	110	198	309	179	132	140	217	272	195
May	-	225	171	444	51	140	163	407	9	201
Jun.	-	305	234	177	428	183	298	391	269	286
Jul.	177	269	250	171	196	199	38	150	36	165
Aug.	108	44	169	97	88	128	107	51	383	131
Sep.	230	39	138	119	164	441	411	18	215	197
Oct.	411	337	495	230	420	343	531	363	146	364
Nov.	373	471	397	222	129	387	437	112	140	296
Dec	30	80	57	0	148	158	216	12	46	83
Total	-	-	-	-	-	-	-	-	-	**2004**

Source : CWRDM Sub Centre, Neyyattinkara

4.7.5 Primary spatial data base for land evaluation

The details of the primary spatial data (maps) on the eleven biophysical factors namely slope, physiography, soil depth, soil texture, soil drainage, soil erosion, elevation, presence of rocks/gravels/stones, soil pH, ground water potential and available major soil nutrients are discussed below.

4.7.5.1 Slope

The data on the slope categories of the watershed area are given in Table 22 and Fig. 10.

Table 22. Slope categories of Aruvipuram watershed

Sl. No.	Slope categories	Area (Ha)	Percentage to the total area
1	0 – 3 % slope	331.92	10.68
2	3 – 8 % slope	356.85	11.48
3	8 – 15 % slope	862.19	27.73
4	15 – 35 % slope	1493.52	48.03
5	35 – 50 % slope	51.33	1.65
6	> 50 % slope	13.31	0.43
Total		3109.12	100.00

The watershed area was categorised into six slope classes. Among the different categories, maximum area (48.03 %) fell in the category of 15-35 per cent slope. This was followed by 8-15 per cent slope (27.73 %), 3-8 per cent slope (11.48 %), 0-3 per cent slope (10.68 %), 35-50 per cent slope (1.65 %) and > 50 per cent slope (0.43 %).

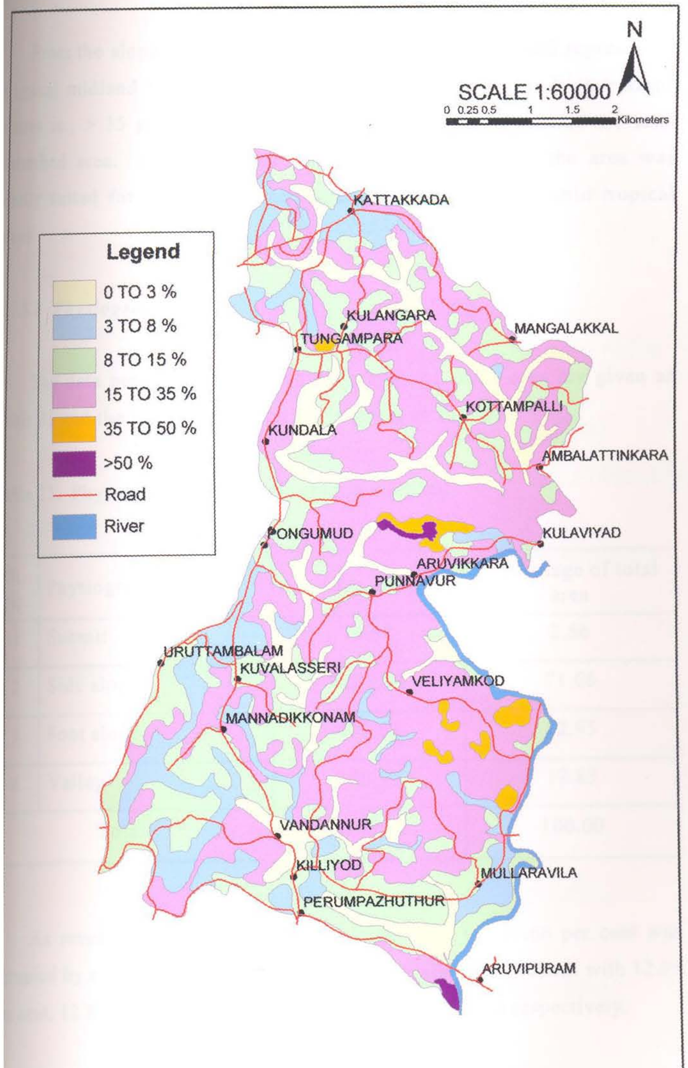

Fig.10 Slope of Aruvipuram watershed

From the slope classes, it was found that the watershed represented a typical midland region of Kerala State. Similarly the higher slope classes ie., > 35 per cent accounted for only 2.08 per cent of the total watershed area. Hence on the basis of the topography, the area was ideally suited for agricultural activities with a range of humid tropical crops.

4.7.5.2 Physiography

The data pertaining to the physiography of study area are given as Table 23 and the spatial presentation is given as Fig. 11.

Table 23. Physiography of Aruvipuram watershed

Sl. No.	Physiography	Area (Ha)	Percentage of total area
1	Submit	79.54	2.56
2	Side slope	2227.91	71.66
3	Foot slope	402.68	12.95
4	Valley	398.99	12.83
Total		3109.12	100.00

As revealed by Table 23 the maximum area ie., 71.66 per cent was occupied by side slope followed by foot slope, valleys and submit with 12.95 per cent, 12.83 per cent and 2.56 per cent of the total area respectively.

This showed that the area represented a typical midland region of Kerala capable of hosting a variety of tropical crops. The submits of Kerala are in general with shallow soils mainly due to erosion. The

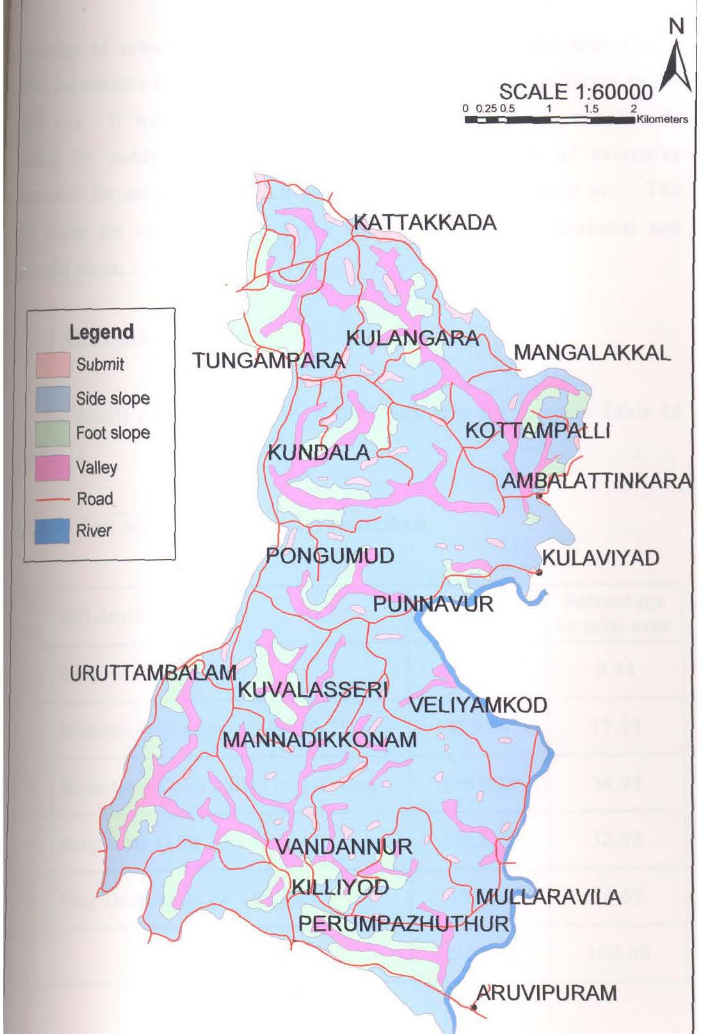

Fig.11 Physiography of Aruvipuram watershed

percentage of submit area was very insignificant and the side slopes which are suitable for a wide range of crops was highly significant in the study area. It was noted that the valley portion which was ideally suitable for paddy crop is presently in the process of extensive conversion for other crops such as banana, tapioca, coconut etc. The foot slopes are ideally suited for a wide range of both seasonal and perennial crops.

4.7.5.3 Soil depth

The details on the soil depth of the study area are given in Table 24 and Fig. 12.

Table 24. Soil depth of Aruvipuram watershed

Sl. No.	Soil depth categories	Area (Ha)	Percentage to total area
1	Shallow soils (25-50 cm)	13.81	0.44
2	Moderately Shallow soils (50-75 cm)	529.59	17.03
3	Moderately Deep soils (75-100 cm)	1087.29	34.98
4	Deep soils (100-150 cm)	1025.29	32.98
5	Very Deep soils (> 150 cm)	453.14	14.57
Total		3109.12	100.00

Table 24 revealed that the maximum area was under the category of moderately deep soil (34.98 %), followed by deep soils (32.98 %). The least extent of area was occupied by shallow soils (0.44 %).

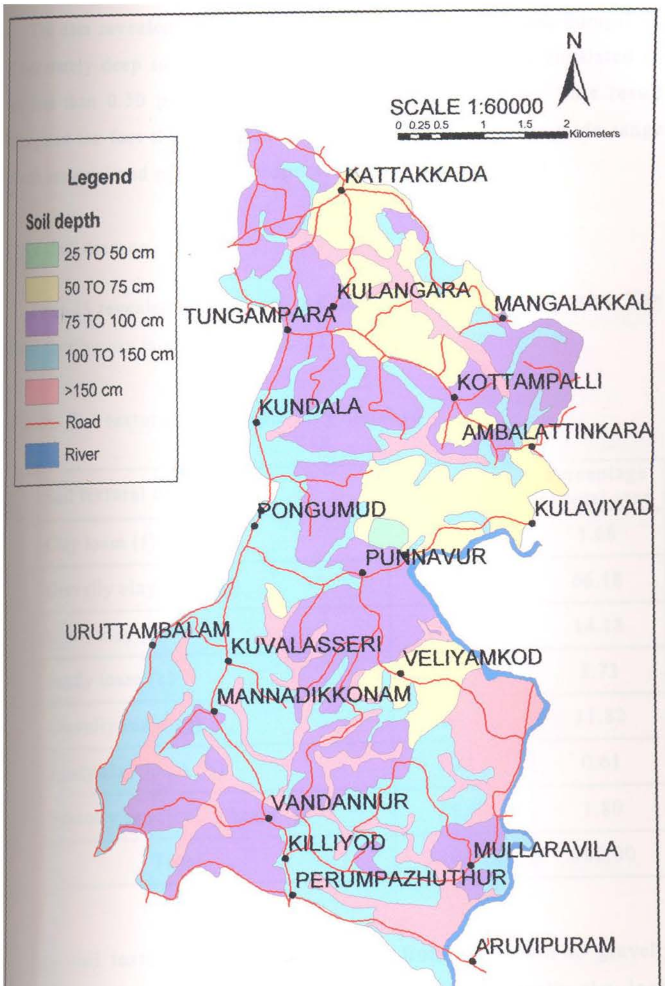

Fig.12 Soil depth of Aruvipuram watershed

The data revealed that more that 82 per cent of the area comprised of moderately deep to very deep soils. The shallow soils consisted of only less than 0.50 per cent, which is very insignificant. This result highlighted the fact that the area is very conducive to host a wide range of both seasonal and perennial crops with regard to soil depth.

4.7.5.4 Soil texture

Table 25 revealed the data on the soil texture of the study area. The spatial distribution is shown as Fig. 13.

Table 25. Soil texture of Aruvipuram watershed

Sl. No.	Soil textural class	Area (Ha)	Percentage to total area
1	Clay loam (f)	52.35	1.68
2	Gravelly clay loam (f)	2057.67	66.18
3	Sandy clay (l)	440.72	14.18
4	Sandy loam (c)	115.85	3.73
5	Gravelly loam (d)	367.56	11.82
6	Sandy clay loam (h)	19.11	0.61
7	Gravelly sandy clay loam (l)	55.86	1.80
Total		3109.12	100.00

The soil texture of the area ranged from clay loam to gravelly sandy clay loam. The maximum area comprised of gravelly clay loam ie., 66.18 per cent. This was followed by sandy clay (14.18 %). The least area was under sandy clay loam (0.61 %). The area under gravelly sandy clay loam and clay loam was 1.80 per cent and 1.68 per cent respectively.

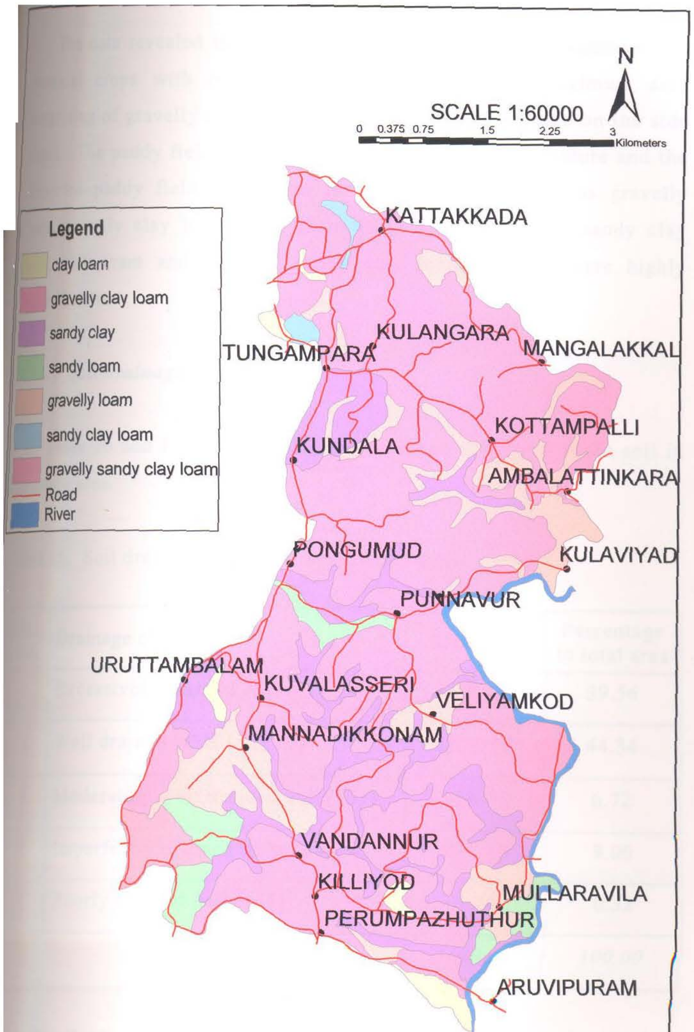

Fig. 13 *Soil texture of Aruvipuram watershed*

The data revealed that the area was suitable for both seasonal and perennial crops with respect to soil texture. The maximum area comprising of gravelly clay loam texture was mainly located on the side slopes. The paddy fields consisted of mainly sandy clay texture and the converted paddy fields consisted for other textures such as gravelly loam, gravelly clay loam, clay loam etc. The area under sandy clay loam, clay loam and gravelly sandy clay loam textures were highly insignificant.

4.7.5.5 Soil drainage

Table 26 and Fig. 14 revealed the drainage condition of the soil in the study area.

Table 26. Soil drainage of Aruvipuram watershed

Sl. No.	Drainage class	Area (Ha)	Percentage to total area
1	Excessively drained soil (d1)	1230.04	39.56
2	Well drained soils (d2)	1378.49	44.34
3	Moderately well drained soils (d3)	208.99	6.72
4	Imperfectly drained soils (d4)	281.80	9.06
5	Poorly drained soils (d5)	9.80	0.32
Total		3109.12	100.00

The Table 26 showed that the major portion of the study area had well drained soils (44.34 %) followed by excessively drained soils (39.56 %). Moderately well drained, imperfectly drained and poorly drained soils consisted of 6.72 per cent, 9.06 per cent and 0.32 per cent respectively.

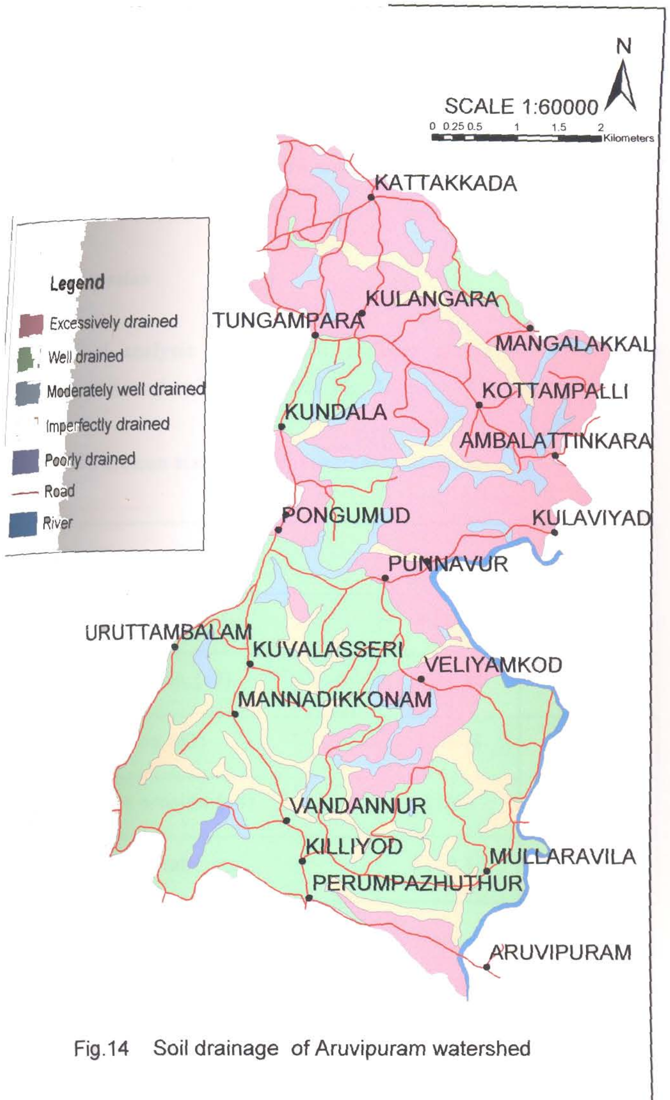

Fig.14 Soil drainage of Aruvipuram watershed

The above findings highlighted that nearly 84 per cent of the area had well drained to excessively drained soils and only less than 10 per cent of the area had imperfect to the poorly drained soils. This is an indication that the watershed area was not susceptible to the problem of permanent water logging and hence was conducive to a wide range of both seasonal and perennial crops.

4.7.5.6 *Soil erosion*

A critical analysis of the soil erosion status of Aruvipuram watershed is presented as Table 27 and Fig. 15.

Table 27. Soil erosion status of Aruvipuram watershed

Sl. No.	Soil erosion class	Area (Ha)	Percentage to total area
1	Slight erosion (e1)	478.48	15.39
2	Moderate erosion (e2)	2088.90	67.19
3	Severe erosion (e3)	520.08	16.73
4	Very severe erosion (e4)	21.66	0.69
Total		3109.12	100.00

The data revealed that major portion of the watershed area (67.19 %) had moderate erosion status which was followed by severe erosion status (16.73 %). The percentage of area under slight erosion and very severe erosion status were 15.39 per cent and 0.69 per cent respectively.

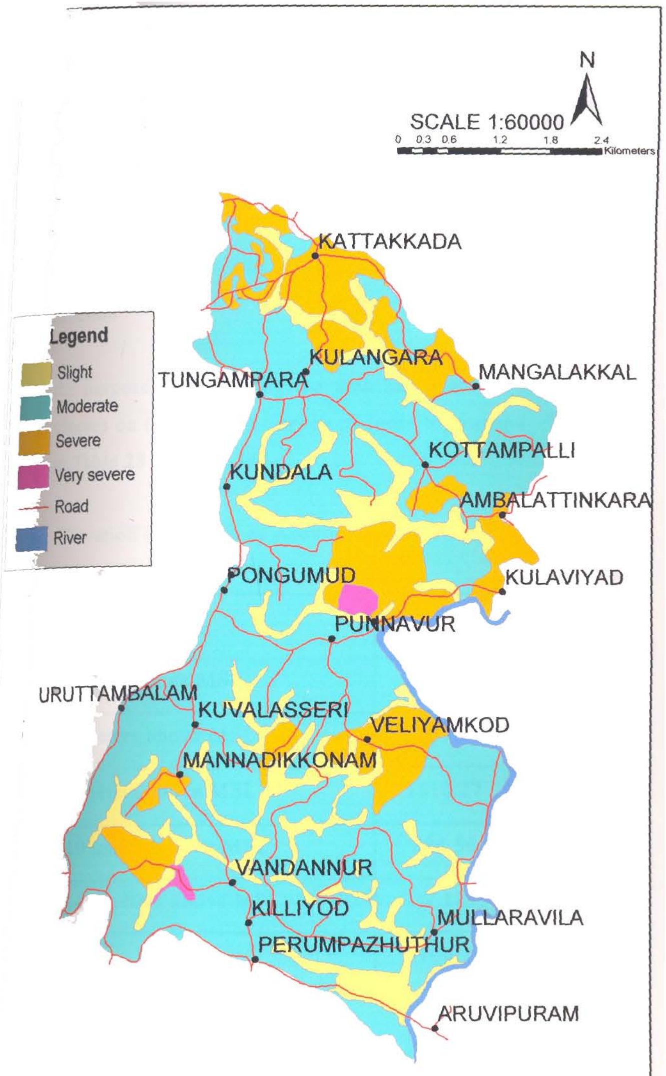

Fig.15 Soil erosion status of Aruvipuram watershed

The area under very severe erosion was insignificant which meant that the area was suitable for agriculture. But the area under moderate to severe erosion constituted nearly 84 per cent of the total area. This highlighted the need for location specific soil conservation measures while undertaking the cultivation practices which involved more soil disturbances.

4.7.5.7 ***Elevation***

For the purpose of this study the area has been grouped into five elevation classes on the basis of Survey of India topo maps. The details are given in Table 28 and Fig. 16.

Table 28. Elevation categories of Aruvipuram watershed

Sl. No.	Elevation categories	Area (Ha)	Percentage to total area
1	< 20 meters above MSL	73.88	2.38
2	20-50 meters above MSL	1233.29	39.67
3	50-80 meters above MSL	1510.27	48.57
4	80-110 meters above MSL	284.56	9.15
5	110-140 meters above MSL	7.12	0.23
Total		3109.12	100.00

The data revealed that the predominant elevation class of the area was between 50 to 80 meters above MSL (48.57 %). This was followed by elevation class 20-50 meters above MSL (39.67 %). The higher class which was between 110-140 meters comprised of only 0.23 per cent.

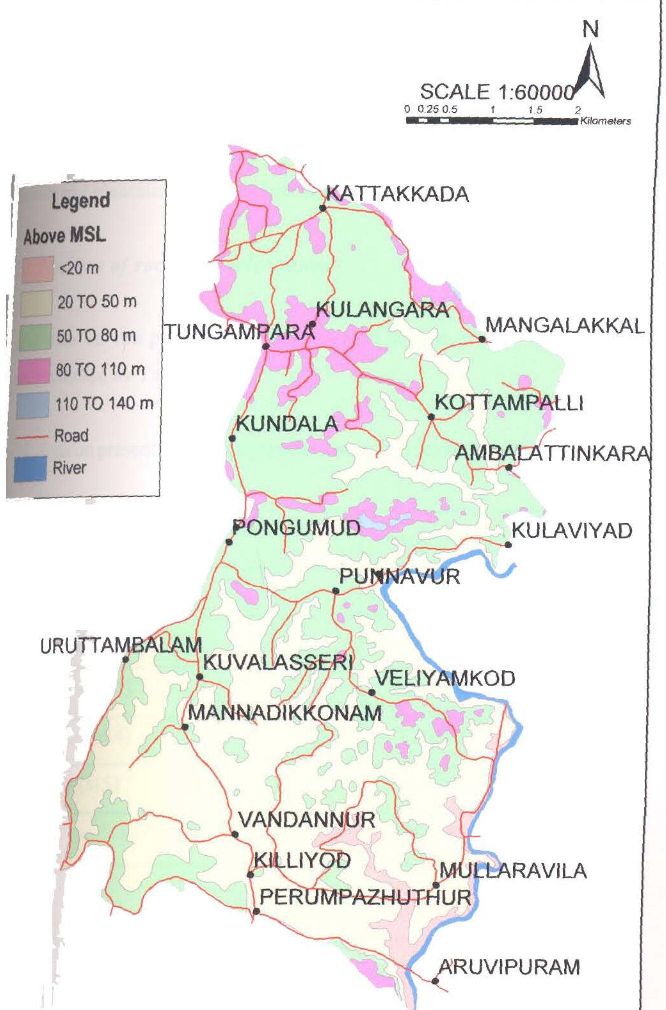

Fig.16 Elevation of Aruvipuram watershed

The study revealed that the area was located in the medium to low elevation ranges, making the watershed suitable to a wide range of seasonal and perennial crops. Hence the predominant land use suitable to the area was agriculture with emphasis on homestead system of agriculture and plantations of tropical crops.

4.7.5.8 Presence of rocks/gravels/stones

The data on the presence of rocks/gravels/stones in the watershed area are presented as Table 29 and Fig. 17.

Table 29. Data on presence of rocks/gravels/stones in Aruvipuram watershed area

Sl. No.	Categories with percentage of rock / gravels / stones	Area (Ha)	Percentage to total area
1	< 3 % (st1)	270.64	8.70
2	3-15 % (st2)	343.88	11.06
3	15-40 % (st3)	2246.71	72.26
4	40-75 % (st4)	176.45	5.68
5	> 75 % (st5)	71.44	2.30
Total		3109.12	100.00

The above data revealed the extent of rocks/gravels/stones present in the surface soil. As per the data, major area had surface soil with 15 to 40 per cent of gravels, which accounted for 72.26 per cent of the total area. This was followed with soil containing 3 to 15 per cent, < 3 per cent, 40 to 75 per cent and > 75 per cent gravels/stones/rocks in the proportion of 11.06 per cent, 8.70 per cent, 5.68 per cent and 2.30 per cent of the total geographical area respectively.

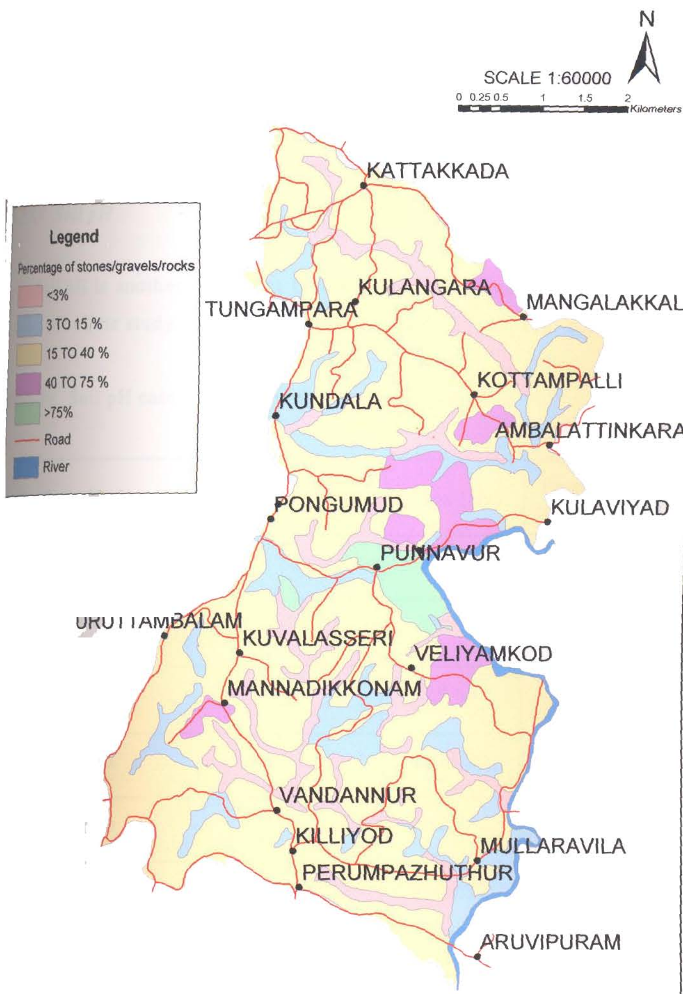

Fig.17 Soil surface stoniness of Aruvipuram watershed

The study revealed that the percentage of graveliness in the watershed area was within the acceptable level for agricultural operations making the area conducive for hosting a wide range of seasonal and perennial crops.

4.7.5.9 Soil pH

Soil pH is another important factor for crop management. The data on soil pH of the study area are presented as Table 30 and Fig. 18.

Table 30. Soil pH categories in Aruvipuram watershed

Sl. No.	Soil pH class	Area (Ha)	Percentage to total area
1	4.5 to 5	384.98	12.38
2	5.1 to 5.5	337.53	10.86
3	5.6 to 6.0	29.68	0.95
4	6.1 to 6.5	2324.23	74.76
5	6.6 to 7.0	32.70	1.05
Total		3109.12	100.00

As per Table 30, major portion (74.76 %) of the watershed area fell in the soil pH range of 6.1 to 6.5. The other categories are pH range 4.5 to 5 (12.38 %), pH range 5.1 to 5.5 (10.86 %), pH range 5.6 to 6.0 (0.95 %) and pH range 6.6 to 7.0 (1.05 %).

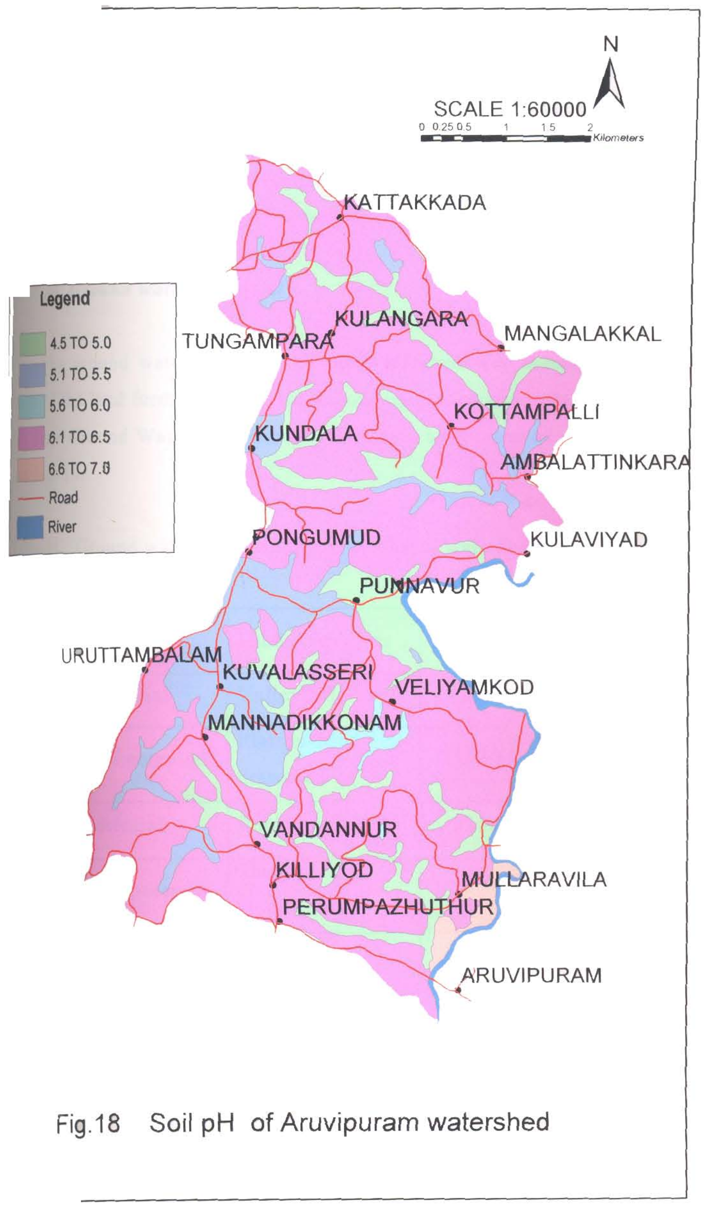

Fig.18 Soil pH of Aruvipuram watershed

The results revealed that major portion of the soils showed towards acidic nature. But it was not very much acidic. Nearly 3/4th of the soil had pH range between 6.1 and 6.5 which allowed a wide range of tropical crops to be grown in the watershed area. Soil tending towards alkaline nature ie., between 6.6 to 7.0 pH was very insignificant in area.

4.7.5.10 Ground water potential

The ground water potential of the watershed was assessed on the basis of the land form units and the secondary information obtained from the State Ground Water Department. The data are presented as Table 31 and Fig. 19.

Table 31. Ground water potential of Aruvipuram watershed

Sl. No.	Ground water potential categories	Land form units	Area (Ha)	Percentage to total area
1	Good potential	Valley fills	435.88	14.02
2	Moderate potential	Plateau-Mod. dissected	2572.59	82.74
3	Poor potential	Residual mount	92.40	2.97
4	Very poor potential	Sheet rock & stone query	8.25	0.27
Total			3109.12	100.00

The data on Table 31 revealed that 82.74 per cent of the area had moderate ground water potential, followed by 14.02 per cent of the area with good potential, 2.97 per cent of the area with poor potential and 0.27 per cent with very poor potential.

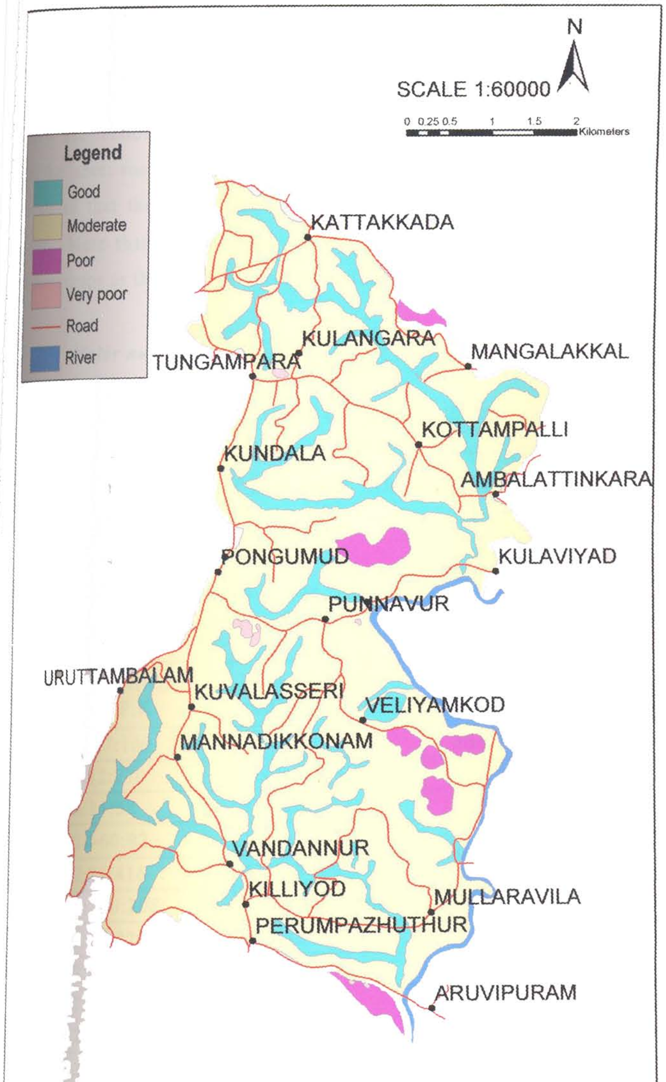

Fig.19 Ground water potential of Aruvipuram watershed

The moderate potential areas are located in the land form 'Plateau-moderately dissected' and good potential area are located in 'valley fills'. The 'residual mounts' possessed poor potential of ground water and the 'sheet rocks' had very poor ground water potential. It can be concluded that the valley fills can host crops which needed more of water. More than 82 per cent of the area can host a wide range of tropical crops as the ground water potential in this area was moderate.

4.7.5.11 Major nutrient status

With the limited soil test data available in the Krishi Bhavans, micro watershed wise soil major nutrient status information was generated for the purpose of this study. The data are presented through Table 32 and Fig. 20.

Table 32. Micro watershed wise soil major nutrient status of Aruvipuram watersed

Sl. No.	*Major nutrient status N:P:K	Micro watershed codes	Area (Ha)	Percentage to total area
1	0.60:8.7:109	1N6a1	361.05	11.61
2	0.22:12:270	1N7a1 & 1N7a2	311.93	10.03
3	0.05:14:82	1N6a6	151.63	4.88
4	0.02:>60:92	1N6a2	257.20	8.27
5	0.20:21:416	1N6a3	228.07	7.34
6	0.20:>60:208	1N6a4 & 1N6a5	377.43	12.13
7	0.14:19:320	1N7a3	196.83	6.33
8	0.22:48:333	1N7a4	76.07	2.45
9	0.07:56:121	1N7a5	195.45	6.29
10	0.12:>60:79	1N7a6	228.10	7.34
11	0.22:50:150	1N7a7	332.02	10.68
12	0.24:>60:95	1N7a8 & 1N7a9	393.34	12.65
	Total		3109.12	100.00

(* N = % of OC; P = kg/ha; K = kg/ha)

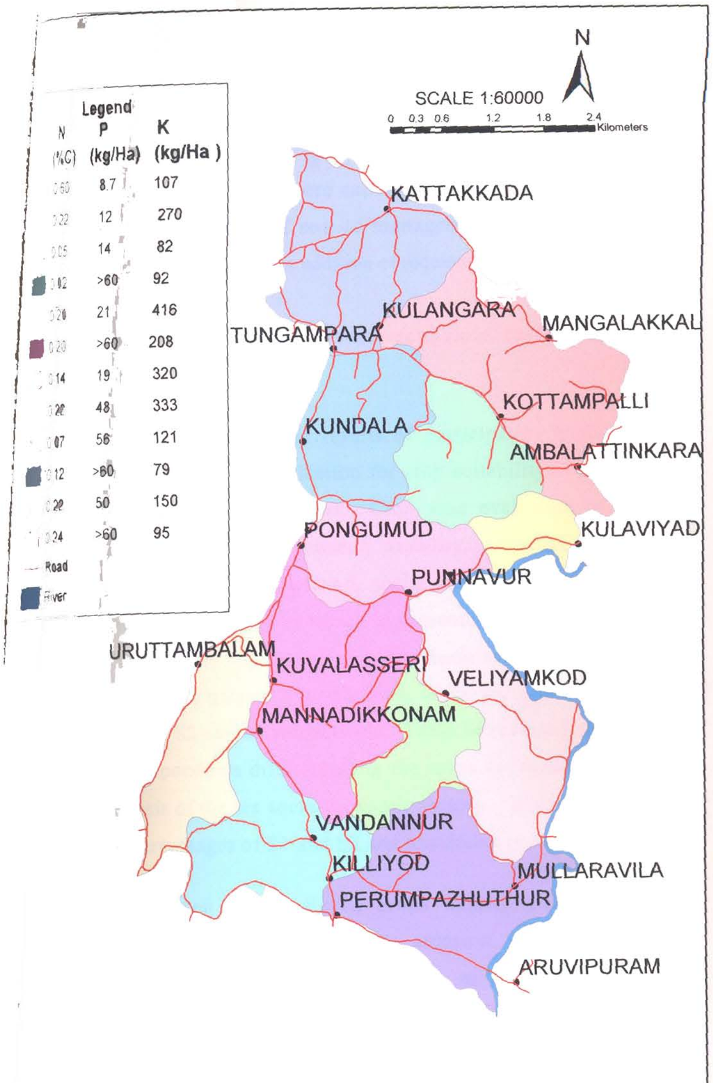

Fig.20 Major nutrients status of the soils of Aruvipuram watershed

The data on Table 32 revealed that in general the major nutrient status of the soils of micro watersheds with respect to Nitrogen, Phosphorus and Potash (N,P,K) was medium to low except in few watersheds, where the potassium level alone was high. Inspite of this limitation, the micro watersheds were capable of hosting a wide range of tropical crops as the response of soil to management was good. Hence the shortage could be overcome by the addition of required quantity of fertilizers.

4.7.6 Participatory evaluation of socio-economic factors for crop suitability

Table 33 and 34 revealed the results of participatory evaluation of socio-economic factors of land evaluation for crop suitability in the context of sustainable agriculture development. Crop wise evaluation of the six socio-economic factors namely economic viability, economic feasibility, infrastructural facilities, market demand, social acceptability and farming experience through participatory approach is presented in the Table 33 and 34. Table 33 showed the percentage of respondents rating the factors for each crop at three levels namely > 80 per cent, 40-80 per cent and < 40 per cent expressed as S1, S2 and S3 respectively. Table 34 revealed the opinion in percentage of respondents differentiating the crops as 'suitable' and 'not suitable' on the basis of the six socio-economic factors. 'Suitable' consisted of the combined percentages of S1 and S2 and unsuitable represented S3.

Out of the fifteen crops, eleven crops namely paddy, coconut, rubber, banana, vegetables, tapioca, cashew, arecanut, pepper, pulses and ginger were considered to be suitable as main crops for the watershed area with respect to all the six socio-economic factors as evident from Table 34. Four crops namely pineapple, mango, sapota and cocoa were considered as unsuitable main crops for the area. Pineapple was considered unsuitable in the context of economic viability, infrastructural facilities and social acceptability.

Table 33. **Percentage of farmers falling in S1, S2 and S3 categories with respect to different socio-economic factors as per their rating**

(n=30)

No	Name of crop	Percentage of respondents																	
		Economic viability			Economic feasibility			Infrastructural facilities			Market demand			Social acceptability			Farming experience		
		S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3
1	Paddy	10	47	43	13	40	47	7	50	43	17	60	23	80	20	0	83	17	0
2	Coconut	23	40	37	17	53	30	10	43	47	33	47	20	87	13	0	80	20	0
3	Rubber	40	60	0	33	60	7	17	46	37	20	73	7	37	50	13	17	43	40
4	Banana	73	27	0	80	20	0	33	50	17	77	23	0	23	60	17	50	43	7
5	Vegetables	13	54	33	3	60	37	23	33	44	7	63	30	37	50	13	27	53	20
6	Tapioca	30	53	17	37	50	13	47	43	10	50	47	3	20	70	10	70	30	0
7	Cashew	23	33	44	13	47	40	20	33	47	30	53	17	7	47	46	14	43	43
8	Arecanut	3	50	47	3	50	47	6	50	44	0	50	50	27	43	30	24	46	30
9	Pineapple	3	40	57	6	44	50	0	33	67	17	40	43	0	23	77	0	56	44
10	Mango	6	33	61	0	27	73	0	63	37	17	40	43	33	50	17	6	37	57
11	Pepper	0	60	40	0	57	43	0	57	43	17	43	40	37	63	0	17	73	10
12	Sapota	0	13	87	0	13	87	0	43	57	0	13	87	0	6	94	0	17	83
13	Pulses	13	57	30	17	66	17	13	70	17	20	37	43	50	37	13	53	47	0
14	Ginger	33	30	37	20	40	40	17	33	50	7	50	43	20	50	30	13	63	24
15	Cocoa	0	17	83	0	7	93	0	7	93	0	10	90	0	23	77	24	63	13
Total		100			100			100			100			100			100		

S1 - > 80 per cent level S2 - 40-80 per cent level S3 - < 40 per cent level

Table 34. Percentage of respondents expressing their suitability of each crop as suitable and not suitable for the watershed area with respect to socio-economic factors

(n=30)

No.	Name of crop	Percentage of respondents											
		Economic viability		Economic feasibility		Infrastructural facilities		Market demand		Social acceptability		Farming experience	
		S	N	S	N	S	N	S	N	S	N	S	N
1	Paddy	57	43	53	47	57	43	77	23	100	0	100	0
2	Coconut	63	37	70	30	53	47	80	20	100	0	100	0
3	Rubber	100	0	93	7	63	37	93	7	87	13	60	40
4	Banana	100	0	100	0	83	17	100	0	83	17	93	7
5	Vegetables	67	33	63	37	56	44	70	30	87	13	80	20
6	Tapioca	83	17	87	13	90	10	97	3	90	10	100	0
7	Cashew	56	44	60	40	53	47	83	17	54	46	57	43
8	Arecanut	53	47	53	47	56	44	50	50	70	30	70	30
9	Pineapple*	43	57	50	50	33	67	57	43	23	77	56	44
10	Mango*	39	61	27	73	63	37	57	43	83	17	43	57
11	Pepper	60	40	57	43	57	43	60	40	100	0	90	10
12	Sapota*	13	87	13	87	43	57	13	87	6	94	17	83
13	Pulses	70	30	83	17	83	17	57	43	87	13	100	0
14	Ginger	63	37	60	40	50	50	57	43	70	30	76	24
15	Cocoa*	17	83	7	93	7	93	10	90	23	77	87	13
	Total	100		100		100		100		100		100	

S = (S1 + S2) – Suitable crop with respect to each factor   N = S3 – Not suitable crop with respect to each factor

* - Not suitable as major crop in the study area with respect to socio-economic factors

Mango was considered unsuitable with respect to economic viability, economic feasibility and farming experience. Sapota was considered unsuitable with respect to all the six factors while cocoa was considered unsuitable with respect to five factors except farming experience.

It was found that social acceptability and infrastructural facilities were the major limitations in growing pineapple a suitable crop. Pineapple had low social acceptability in the area as a main crop due to two reasons such as problem of theft and the menace of reptiles in the dwelling area. In terms of infrastructural facilities, lack of agro-based industries and poor storage facilities were the major problems. In the case of mango the reasons were low economic viability and low economic feasibility as expressed by the respondents. This was due to the unpredictable price fluctuations and high pest infestations. With regard to cocoa crop even though farming experience in the area was high, all other factors were very low as opined by the respondents. The details in frequency of rating by the thirty respondents are given as Appendix XI.

4.7.7 Spatial crop suitability model

The integration of spatial database of eleven biophysical factors on GIS platform helped in generating a 1:10,000 scale map showing the spatial distribution of the Land Mapping Units in the watershed area. This map was supported with a tabular data base highlighting the characteristics of individual Land Mapping Unit. The map along with the tabular database was termed as the 'spatial crop suitability model' for the purpose of this study. The same are presented as Table 35 and Figures 21.1 to 21.15.

Table 35. Characteristics of Land Mapping Units (LMUs) of Aruvipuram watershed with the respective crop suitability recommendations

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
1	3.608	2	4	1	4	11	2	st3	3	4	4	d1	H	C	U	H	C	U
2	2.819	2	4	2	4	11	2	st3	3	4	4	d1	C	U	O	C	U	H
3	1.793	2	4	2	3	11	2	st3	3	4	4	d1	C	U	O	C	U	H
4	0.224	2	4	1	5	11	2	st3	3	4	4	d1	H	C	U	H	C	U
5	3.473	2	4	2	3	11	2	st3	3	3	4	d1	C	U	O	C	U	H
6	2.285	2	4	2	3	11	2	st3	3	3	4	d1	C	U	O	C	U	H
7	2.033	2	4	2	3	11	2	st3	3	4	4	d1	C	U	O	C	U	H
8	3.715	2	4	2	3	11	2	st3	3	4	4	d1	C	U	M	C	U	H
9	1.647	2	4	2	4	11	2	st3	3	3	4	d1	C	U	L	C	U	L
10	12.360	2	4	2	4	11	2	st3	2	2	4	d1	I	U	C	U	C	B
11	0.874	2	4	2	4	11	2	st3	3	3	4	d1	C	U	L	C	U	L
12	0.493	6	5	4	3	11	1	st1	1	4	1	d3	A	B	V	A	B	V
13	0.756	2	4	4	3	11	1	st3	3	4	4	d3	A	B	V	A	B	V
14	5.187	6	5	4	3	11	1	st1	1	1	1	d3	P	V	B	P	V	B
15	0.209	2	4	4	3	11	2	st3	3	4	4	d1	A	B	C	A	B	C
16	0.777	6	5	2	3	11	1	st1	1	3	1	d3	A	B	V	A	B	V
17	11.809	2	4	2	3	11	2	st3	3	4	4	d1	U	C	I	U	C	H
18	0.346	2	4	2	3	11	2	st3	3	1	4	d1	A	B	T	A	B	T
19	0.516	2	4	1	4	11	2	st3	2	3	4	d1	H	C	U	H	C	U
20	0.383	2	4	2	4	11	2	st3	2	3	4	d1	I	C	U	C	U	H
21	0.591	2	3	2	4	11	2	st3	3	2	4	d1	M	I	C	H	C	U
22	25.474	2	3	2	3	11	2	st3	3	2	4	d1	H	M	C	H	C	U
23	0.575	2	4	2	3	11	1	st3	2	3	4	d3	C	U	B	C	U	B
24	0.507	2	4	1	3	11	2	st3	2	3	4	d1	H	C	U	H	C	U
25	1.901	2	4	2	3	11	2	st3	2	3	4	d1	C	M	O	C	U	T
26	1.268	6	5	4	3	11	2	st1	1	1	1	d3	T	B	V	T	B	V
27	0.528	2	3	1	4	11	2	st3	3	2	4	d1	H	I	C	H	C	U
28	1.581	2	4	2	3	11	2	st3	2	2	4	d1	C	U	L	C	U	L
29	0.369	2	4	1	3	11	2	st3	2	2	4	d1	H	C	U	H	C	U
30	0.966	2	4	4	3	11	2	st3	3	1	4	d1	A	B	C	A	B	C
31	1.159	2	3	1	4	11	2	st3	3	4	4	d1	H	I	C	H	C	U
32	2.307	2	4	1	4	11	2	st3	3	4	4	d1	H	C	U	H	C	U
33	9.013	2	4	3	4	11	2	st3	2	2	4	d1	C	U	T	C	U	T
34	0.965	2	3	2	3	11	2	st3	3	4	4	d1	I	M	H	H	U	C
35	2.519	2	3	1	3	11	2	st3	3	4	4	d1	H	I	M	H	U	C
36	0.321	2	4	2	3	11	2	st3	3	1	4	d1	C	B	T	C	B	T
37	1.272	2	3	1	4	11	2	st3	3	4	4	d1	H	I	M	H	U	C
38	0.229	2	4	2	4	11	2	st3	2	2	4	d1	C	U	O	C	U	T

* Details given at the end of the table

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
39	0.305	2	4	2	3	11	1	st3	2	2	4	d3	C	U	O	C	U	B
40	3.924	2	4	2	4	11	2	st3	2	3	4	d1	C	U	O	C	U	T
41	0.245	2	4	2	4	11	2	st3	2	4	4	d1	C	U	O	C	U	T
42	1.716	2	4	3	3	11	2	st3	2	2	4	d1	C	R	U	C	R	U
43	1.664	2	3	2	3	11	1	st3	3	2	4	d1	H	I	W	H	W	U
44	0.246	2	3	1	3	11	2	st3	3	2	4	d1	H	I	W	H	U	W
45	2.340	2	3	2	3	11	2	st3	3	4	4	d1	H	I	W	H	W	U
46	1.258	2	3	2	4	11	2	st3	3	4	4	d1	H	I	W	H	W	U
47	1.560	2	4	2	4	11	2	st3	3	4	4	d1	C	U	O	C	U	T
48	0.934	2	4	2	3	11	2	st3	3	4	4	d1	C	U	O	C	U	T
49	0.240	2	4	2	4	11	2	st3	3	3	4	d1	C	U	O	C	U	T
50	0.574	6	5	2	3	11	2	st1	1	1	1	d3	I	T	B	C	T	B
51	2.551	2	3	2	4	11	2	st3	3	2	4	d1	H	I	C	H	U	C
52	0.933	2	3	4	3	11	2	st3	3	2	4	d1	I	T	C	H	T	C
53	0.509	2	3	4	3	11	2	st3	3	2	4	d1	I	T	C	H	T	C
54	1.883	2	3	4	3	11	1	st3	3	2	4	d2	B	T	C	B	T	C
55	0.325	2	3	4	3	11	1	st3	3	4	4	d1	B	W	C	B	W	C
56	4.478	2	4	3	3	11	2	st3	3	4	4	d1	C	U	N	C	U	N
57	3.237	2	4	2	3	11	2	st3	2	3	4	d1	C	U	N	C	U	N
58	0.271	5	4	4	3	11	1	st3	2	4	4	d2	C	R	T	C	R	T
59	0.826	5	4	2	3	11	1	st3	2	4	4	d2	C	B	T	C	B	T
60	2.912	5	4	2	3	11	2	st3	2	4	4	d1	C	B	N	C	B	N
61	0.580	1	5	4	3	11	2	st2	2	1	2	d2	A	R	C	A	R	C
62	0.989	2	4	2	3	11	1	st3	3	4	4	d1	C	U	S	C	U	W
63	1.675	1	5	4	3	11	1	st2	2	1	2	d2	B	T	V	B	T	V
64	1.898	5	4	2	3	11	2	st3	2	2	4	d1	C	U	T	C	U	T
65	0.268	2	3	1	4	11	2	st3	3	2	4	d1	H	C	U	H	C	U
66	4.226	5	5	4	3	11	1	st3	1	1	2	d3	P	V	B	P	V	B
67	0.226	2	3	2	4	11	2	st3	3	4	4	d1	H	C	U	H	C	U
68	0.643	2	4	4	3	11	2	st3	3	1	4	d1	A	C	T	A	C	T
69	0.268	2	4	2	3	11	2	st3	2	4	4	d1	C	U	N	C	U	N
70	0.232	5	4	2	3	11	2	st3	2	4	4	d1	C	U	N	C	U	N
71	1.735	2	3	1	4	11	2	st3	3	3	4	d1	H	I	W	H	W	U
72	1.534	2	3	2	4	11	2	st3	3	3	4	d1	H	I	W	H	W	U
73	2.255	2	3	2	3	11	2	st3	3	3	4	d1	H	I	W	H	W	U
74	0.431	1	5	2	3	11	1	st2	2	1	2	d2	T	C	B	T	C	B
75	0.255	2	3	2	3	11	2	st3	3	3	4	d1	M	I	C	H	C	U
76	12.237	2	3	2	3	11	2	st3	3	4	4	d1	M	I	C	H	U	C
77	0.212	5	4	2	4	11	2	st3	2	2	4	d1	C	U	T	C	U	T
78	0.550	2	3	2	3	11	1	st3	3	4	4	d1	H	C	U	H	C	U

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
79	0.271	6	5	4	3	11	1	st1	1	1	1	d3	T	B	V	T	B	V
80	0.251	5	5	2	3	11	1	st3	1	4	2	d3	C	U	L	C	U	L
81	0.404	2	3	1	3	11	2	st3	3	3	4	d1	H	I	C	H	U	C
82	0.465	1	5	2	3	11	1	st2	2	4	2	d2	C	U	T	C	U	T
83	6.372	2	4	3	4	11	2	st3	2	3	4	d1	C	T	U	C	T	U
84	1.332	5	4	2	4	11	2	st3	2	4	4	d1	C	U	T	C	U	T
85	0.604	5	5	4	3	11	1	st3	1	4	2	d3	C	B	T	C	B	T
86	0.227	2	4	2	3	11	2	st3	3	3	4	d1	C	U	T	C	U	T
87	0.645	5	5	4	3	11	2	st3	1	1	2	d3	T	B	V	T	B	V
88	0.368	2	4	3	3	11	2	st3	2	4	4	d1	C	U	T	C	U	T
89	0.274	2	3	2	4	11	2	st3	3	4	4	d1	H	C	U	H	C	U
90	0.756	5	4	3	3	11	2	st3	2	4	4	d1	C	U	T	C	U	T
91	0.719	2	3	1	3	11	2	st3	3	4	4	d1	H	C	U	H	C	U
92	0.293	2	3	2	4	11	2	st3	3	4	4	d1	H	C	U	H	C	U
93	0.349	2	6	4	3	11	2	st1	1	4	1	d4	T	I	B	A	T	B
94	15.330	2	6	4	3	11	1	st1	1	1	1	d4	P	V	B	P	V	B
95	1.248	2	3	2	3	11	2	st3	3	3	4	d1	H	C	U	H	C	U
96	1.632	2	3	3	3	11	2	st3	3	3	4	d1	H	C	U	H	C	U
97	0.649	2	3	4	3	11	2	st3	3	1	4	d1	T	B	C	T	B	C
98	0.454	2	3	4	3	11	2	st3	3	4	4	d1	H	C	U	H	C	U
99	0.227	5	5	4	3	11	2	st3	1	4	2	d3	T	B	C	T	B	C
100	0.849	5	4	2	3	12	2	st3	2	4	4	d1	C	U	N	C	U	N
101	0.701	1	5	2	3	11	2	st2	2	4	2	d2	C	B	T	C	B	T
102	0.363	2	3	3	3	11	1	st3	3	3	4	d1	H	C	T	H	C	T
103	0.211	2	3	1	3	11	2	st3	3	4	4	d1	H	C	U	H	C	U
104	1.284	2	3	1	3	11	2	st3	3	3	4	d1	H	C	U	H	C	U
105	0.367	2	3	2	3	11	2	st3	3	1	4	d1	C	W	T	C	W	T
106	0.474	2	6	2	3	11	1	st1	1	4	1	d4	C	U	B	C	U	B
107	0.283	2	3	2	3	11	1	st3	3	4	4	d1	H	I	C	H	U	C
108	0.282	2	6	4	3	11	1	st1	1	4	1	d4	I	T	B	A	T	B
109	0.211	2	3	4	3	11	1	st3	3	4	4	d1	I	C	B	C	U	B
110	0.257	2	3	2	3	11	1	st3	3	4	4	d1	H	C	U	H	C	U
111	11.708	2	4	3	3	11	2	st3	2	3	4	d1	C	U	R	C	U	R
112	0.720	5	4	2	4	12	2	st3	2	4	4	d1	C	U	R	C	U	R
113	0.966	2	6	4	3	11	2	st1	1	1	1	d4	P	V	B	P	V	B
114	0.416	2	3	3	3	11	1	st3	3	1	4	d1	R	B	C	R	B	C
115	1.584	2	3	2	3	12	2	st3	3	3	4	d1	M	C	U	H	C	U
116	0.385	2	3	4	3	11	2	st3	3	1	4	d1	M	C	T	H	C	T
117	0.614	2	3	4	3	11	1	st3	3	1	4	d1	P	B	C	P	B	C
118	0.755	2	4	3	3	11	2	st3	2	1	4	d1	C	R	L	C	R	L

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
119	0.388	2	4	4	3	11	2	st3	2	1	4	d1	C	B	T	C	B	T
120	0.335	2	4	4	3	11	1	st3	2	1	4	d1	C	B	T	C	B	T
121	1.343	2	4	2	3	11	2	st3	2	1	4	d1	C	U	T	C	U	T
122	0.265	2	3	2	3	11	2	st3	3	3	4	d1	M	C	T	C	U	T
123	1.872	2	3	2	3	11	2	st3	3	3	4	d1	M	C	T	C	U	T
124	0.244	2	4	2	3	11	1	st3	2	1	4	d1	C	U	R	C	U	R
125	1.446	2	5	2	4	12	2	st3	2	4	4	d2	C	U	L	C	U	L
126	0.613	2	3	3	3	11	1	st3	3	3	4	d1	I	W	C	W	C	U
127	0.773	2	3	2	3	12	2	st3	3	4	4	d1	I	W	C	H	W	C
128	1.316	5	5	4	3	11	2	st2	2	2	2	d3	C	B	V	C	B	V
129	0.408	2	3	2	3	11	1	st3	3	3	4	d1	M	C	U	C	U	T
130	3.806	5	5	4	3	11	1	st2	2	2	2	d3	C	U	L	C	U	L
131	0.613	2	6	4	3	11	2	st1	1	1	1	d4	P	V	B	P	V	B
132	8.781	2	4	2	3	11	2	st3	2	4	4	d1	C	U	L	C	U	L
133	1.378	2	3	3	3	12	2	st3	3	4	4	d1	W	C	U	W	C	U
134	1.297	2	4	2	3	11	2	st3	2	2	4	d1	C	U	T	C	U	T
135	0.400	2	6	4	3	11	2	st1	1	1	1	d4	P	V	B	P	V	B
136	2.464	2	3	3	3	12	2	st3	3	3	4	d1	W	C	U	W	C	U
137	0.267	2	5	2	3	12	2	st3	2	3	4	d2	C	U	L	C	U	L
138	0.336	5	5	2	3	11	1	st2	2	2	2	d3	C	U	B	C	U	B
139	2.857	2	5	2	4	12	3	st3	2	4	4	d2	U	C	W	U	C	W
140	6.187	2	5	2	3	12	2	st3	2	4	4	d2	C	U	T	C	U	T
141	0.227	2	6	3	3	11	1	st1	1	1	1	d4	R	V	B	R	V	B
142	0.506	2	6	4	3	11	2	st1	1	1	1	d4	P	V	B	P	V	B
143	0.216	2	3	3	3	11	1	st3	3	4	4	d1	I	C	U	H	C	U
144	0.208	2	6	3	3	11	2	st1	1	1	1	d4	B	C	V	B	C	V
145	0.403	2	6	4	3	11	1	st1	1	4	1	d4	V	B	C	V	B	C
146	5.598	2	3	3	3	11	2	st3	3	4	4	d1	C	B	T	C	B	T
147	0.789	2	5	1	4	12	3	st3	2	4	4	d2	U	C	S	U	C	H
148	0.435	2	3	2	3	11	1	st3	3	4	4	d1	B	C	T	B	C	T
149	7.782	2	4	2	3	11	2	st3	2	3	4	d1	C	U	T	C	U	T
150	1.380	2	5	3	3	12	2	st3	2	4	4	d2	C	U	R	C	U	R
151	0.327	5	5	3	3	11	2	st2	2	2	2	d3	C	R	U	C	R	U
152	6.100	2	3	2	3	11	2	st3	3	4	4	d1	W	C	U	W	C	U
153	0.342	2	4	2	3	11	1	st3	2	4	4	d1	C	U	L	C	U	L
154	1.141	2	3	2	5	12	3	st4	3	3	4	d2	M	C	U	H	C	U
155	2.147	2	3	2	4	12	3	st4	3	3	4	d2	M	C	U	H	C	U
156	1.930	2	5	1	4	12	3	st3	2	3	4	d2	U	C	L	U	C	L
157	7.135	2	6	4	3	12	1	st1	1	1	1	d4	P	V	B	P	V	B
158	2.515	2	4	3	4	11	2	st3	2	2	4	d1	C	U	T	C	U	T

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
159	2.039	2	5	2	4	12	2	st3	2	4	4	d2	C	U	R	C	U	R
160	0.835	2	5	3	3	11	2	st3	2	2	4	d1	C	B	U	C	B	U
161	0.858	2	6	3	3	12	2	st1	1	1	1	d4	V	B	T	V	B	T
162	0.559	2	3	2	3	12	1	st3	3	4	4	d1	I	C	U	H	C	U
163	0.365	2	3	4	3	12	1	st3	3	1	4	d1	W	I	C	W	C	T
164	0.692	2	4	2	3	11	1	st3	2	2	4	d1	C	U	T	C	U	T
165	1.742	2	3	3	3	11	2	st3	3	3	4	d1	I	W	C	W	C	T
166	0.982	2	4	4	3	11	1	st3	2	2	4	d2	A	C	U	A	C	U
167	1.727	2	6	4	3	12	2	st1	1	1	1	d4	P	V	B	P	V	B
168	6.876	1	5	3	4	11	2	st3	2	2	4	d1	C	B	N	C	B	N
169	3.202	2	3	3	3	12	2	st3	3	4	4	d1	I	W	C	W	C	T
170	2.645	6	5	3	3	11	2	st2	2	4	4	d1	C	L	U	C	L	U
171	2.723	2	3	2	3	12	2	st3	3	4	4	d1	H	C	U	H	C	U
172	0.317	2	4	3	3	11	1	st3	2	2	4	d1	C	B	T	C	B	T
173	0.626	2	4	4	3	11	2	st3	2	2	4	d1	A	C	N	A	C	N
174	2.612	2	4	3	3	11	2	st3	2	3	4	d1	C	N	L	C	N	L
175	2.486	2	3	2	3	11	2	st3	3	3	4	d1	H	C	N	H	C	N
176	0.416	6	5	4	3	11	2	st2	2	2	4	d1	A	C	N	A	C	N
177	0.475	2	3	3	3	12	2	st3	3	3	4	d1	I	C	B	H	C	B
178	0.433	2	6	2	3	12	1	st1	1	4	1	d3	C	B	V	C	B	V
179	0.274	2	4	3	3	11	1	st3	2	3	4	d1	C	W	T	C	W	T
180	0.842	2	4	2	3	11	2	st3	2	4	4	d1	C	U	T	C	U	T
181	0.471	2	4	2	3	11	1	st3	2	4	4	d1	A	C	U	A	C	U
182	4.889	2	3	2	4	12	2	st4	3	4	4	d2	I	C	W	H	C	W
183	1.106	6	5	4	3	11	1	st2	2	2	4	d1	C	L	T	C	L	T
184	2.469	2	4	3	3	11	2	st3	2	4	4	d1	C	U	N	C	U	N
185	7.371	2	4	2	4	11	2	st3	2	3	4	d1	C	U	N	C	U	N
186	1.355	2	3	2	3	12	2	st3	3	3	4	d1	I	C	U	H	C	U
187	4.778	2	4	2	4	11	2	st3	2	4	4	d1	C	U	T	C	U	T
188	0.861	1	5	3	3	11	2	st3	2	2	4	d1	C	R	L	C	R	L
189	0.538	6	5	4	3	11	2	st2	2	4	4	d1	A	C	U	A	C	U
190	0.330	6	5	3	3	11	1	st2	2	2	4	d1	A	C	R	A	C	R
191	6.718	2	3	2	3	12	2	st4	3	4	4	d2	H	I	C	H	C	U
192	1.904	5	5	4	3	11	1	st2	2	2	1	d3	B	V	C	B	V	C
193	1.272	5	5	2	3	11	1	st2	2	2	1	d3	B	C	R	B	C	R
194	3.793	2	4	3	4	11	2	st3	2	3	4	d1	C	U	T	C	U	T
195	2.266	6	5	3	4	11	2	st2	2	3	4	d1	C	U	T	C	U	T
196	0.464	6	5	3	3	11	1	st2	2	4	4	d1	C	U	L	C	U	L
197	2.678	6	5	3	4	11	2	st2	2	4	4	d1	C	U	T	C	U	T
198	0.358	2	6	3	3	12	1	st1	1	1	1	d4	V	B	C	V	B	C

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
199	0.969	2	4	4	3	11	2	st3	2	4	4	d1	A	C	U	A	C	U
200	2.592	2	3	3	3	12	2	st3	3	4	4	d1	I	O	C	H	U	C
201	0.354	5	5	4	3	11	2	st2	2	2	1	d3	A	B	C	A	B	C
202	0.653	2	3	3	3	12	2	st3	2	1	4	d1	I	O	C	W	H	C
203	3.810	2	3	3	3	12	2	st3	2	3	4	d1	I	O	C	H	C	U
204	1.467	2	4	2	4	11	2	st3	2	4	4	d1	C	U	T	C	U	T
205	0.236	2	3	3	3	12	1	st3	2	4	4	d1	H	C	U	H	C	U
206	1.622	2	3	2	3	12	2	st3	3	4	4	d1	H	C	U	H	C	U
207	1.477	2	3	3	3	12	2	st3	2	4	4	d1	H	C	U	H	C	U
208	1.927	2	3	2	3	12	2	st3	3	3	4	d1	H	C	U	H	C	U
209	7.317	2	3	2	3	12	2	st3	3	4	4	d1	H	C	U	H	C	U
210	0.733	2	3	2	3	12	1	st3	2	4	4	d1	H	C	U	H	C	U
211	3.173	2	3	3	3	12	2	st3	2	4	4	d1	H	C	U	H	C	U
212	0.730	2	3	3	2	12	2	st3	3	4	4	d1	H	C	U	H	C	U
213	0.705	2	6	3	2	12	1	st1	1	4	1	d4	B	V	T	B	V	T
214	19.110	2	6	4	2	12	1	st1	1	1	1	d4	P	V	B	P	V	B
215	0.477	2	3	4	3	12	2	st3	3	4	4	d1	A	C	T	A	C	T
216	0.484	2	4	2	4	12	2	st3	2	4	4	d1	A	C	T	A	C	T
217	0.257	2	6	4	3	12	1	st1	1	1	1	d4	P	V	B	P	V	B
218	2.445	2	3	2	3	12	2	st3	2	4	4	d1	M	C	U	H	C	U
219	0.233	2	4	4	3	11	2	st3	2	2	4	d1	A	C	L	A	C	L
220	0.630	2	3	2	4	12	2	st4	3	3	4	d2	H	C	U	H	C	U
221	1.875	2	3	2	3	12	2	st3	2	3	4	d1	H	C	U	H	C	U
222	1.408	2	4	2	4	12	2	st3	2	3	4	d1	C	U	L	C	U	L
223	1.155	2	4	2	3	12	2	st3	2	4	4	d1	C	U	L	C	U	L
224	0.343	2	6	4	2	12	1	st1	1	1	1	d4	P	V	B	P	V	B
225	1.697	2	3	2	3	12	2	st3	3	3	4	d1	H	I	C	H	C	U
226	1.431	2	4	1	4	12	2	st3	2	3	4	d1	H	U	C	H	U	C
227	1.480	2	3	2	3	12	2	st4	3	3	4	d2	H	U	C	H	U	C
228	0.869	2	4	1	4	11	2	st3	2	3	4	d1	C	U	T	C	U	T
229	0.894	2	4	2	3	11	2	st3	2	4	4	d1	C	U	T	C	U	T
230	1.531	2	3	2	3	12	1	st3	3	4	4	d1	H	U	C	H	U	C
231	9.443	2	3	2	4	12	2	st3	2	4	4	d1	H	C	U	H	C	U
232	0.644	2	3	2	3	12	2	st4	3	4	4	d2	H	U	C	H	U	C
233	1.180	2	3	2	3	12	1	st3	3	3	4	d1	H	U	C	H	U	C
234	9.905	2	5	2	3	12	2	st3	2	3	4	d1	C	U	T	C	U	T
235	1.362	2	3	2	2	12	2	st3	3	3	4	d1	H	C	U	H	C	U
236	2.417	2	4	2	4	12	2	st3	2	4	4	d1	C	U	S	C	U	T
237	0.511	2	3	2	2	12	2	st3	3	4	4	d1	H	C	U	H	C	U
238	0.974	2	3	2	2	12	1	st3	3	3	4	d1	H	C	U	H	C	U

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
239	1.802	2	3	2	4	12	2	st3	2	3	4	d1	H	C	U	H	C	U
240	1.081	2	4	2	3	12	2	st3	2	4	4	d1	U	C	T	U	C	T
241	0.293	2	4	4	3	12	1	st3	2	4	4	d1	I	C	U	C	U	B
242	13.844	2	4	2	3	12	2	st3	2	4	4	d1	U	C	N	U	C	N
243	1.079	2	4	2	2	12	2	st3	2	4	4	d1	C	U	L	C	U	L
244	0.210	2	4	2	3	12	1	st3	2	4	4	d1	C	U	L	C	U	L
245	0.586	2	4	2	4	11	1	st3	2	4	4	d1	C	U	L	C	U	L
246	4.597	2	4	2	3	12	2	st3	2	3	4	d1	C	U	L	C	U	L
247	1.981	2	3	2	3	12	2	st3	2	3	4	d1	M	C	U	C	U	T
248	1.354	2	3	2	4	12	2	st3	2	3	4	d1	M	C	U	C	U	T
249	0.668	2	4	2	4	12	2	st3	2	3	4	d1	C	U	T	C	U	T
250	1.981	2	4	2	4	11	2	st3	2	5	4	d1	U	C	R	U	C	R
251	0.456	2	4	2	3	11	2	st3	2	3	4	d1	C	U	L	C	U	L
252	1.525	2	4	2	4	11	2	st3	2	3	4	d1	C	U	L	C	U	L
253	0.823	2	3	1	4	12	2	st3	2	3	4	d1	H	C	U	H	C	U
254	0.962	2	6	4	2	12	1	st1	1	1	1	d4	P	V	B	P	V	B
255	0.874	2	4	2	4	11	2	st3	2	4	4	d1	C	U	T	C	U	T
256	1.668	2	4	2	4	11	4	st3	2	5	4	d1	U	C	O	U	H	C
257	16.756	2	4	2	3	12	2	st3	2	4	4	d1	U	C	O	U	C	T
258	5.080	2	3	2	4	10	2	st3	2	3	4	d1	I	C	U	H	C	U
259	0.264	2	4	2	4	10	2	st3	2	4	4	d1	C	U	N	C	U	N
260	2.126	2	3	1	4	12	2	st3	2	4	4	d1	H	C	U	H	C	U
261	0.210	2	3	1	4	10	2	st3	2	3	4	d1	H	C	U	H	C	U
262	1.946	2	5	2	3	12	2	st3	2	4	4	d1	C	U	N	C	U	N
263	2.351	2	3	2	4	10	2	st3	2	4	4	d1	H	C	U	H	C	U
264	0.460	2	6	2	2	12	1	st1	1	4	1	d4	C	B	L	C	B	L
265	0.651	2	3	2	4	10	2	st3	2	4	4	d1	H	C	U	H	C	U
266	0.596	2	3	2	4	10	2	st3	2	3	4	d1	H	W	C	H	W	C
267	1.566	3	4	1	4	11	2	st3	2	3	4	d2	U	C	W	U	C	W
268	1.526	2	3	2	3	10	2	st3	2	4	4	d1	H	C	U	H	C	U
269	0.723	3	4	2	4	11	2	st3	2	3	4	d2	C	U	L	C	U	L
270	0.855	5	5	2	3	12	2	st2	1	4	1	d3	C	U	L	C	U	L
271	3.527	5	5	4	3	12	2	st2	1	1	1	d3	B	V	T	B	V	T
272	0.368	2	3	1	4	10	2	st3	2	4	4	d1	H	C	U	H	C	U
273	0.654	3	4	1	4	10	2	st3	2	3	4	d2	U	C	N	U	C	N
274	1.810	3	4	1	4	10	2	st3	2	3	4	d2	U	C	N	U	C	N
275	4.279	5	5	4	3	12	1	st2	1	1	1	d3	B	V	T	B	V	T
276	7.335	3	4	2	4	10	2	st3	2	3	4	d2	C	U	O	C	U	T
277	1.063	2	5	2	2	12	2	st3	2	4	4	d1	C	U	O	C	U	H
278	6.123	3	4	2	4	10	2	st3	2	3	4	d2	C	U	I	C	U	T

Table 35 (Contd…)

LMU ID	AREA (Ha)	BIO-PHYSICAL FACTORS											INITIAL CROP SUT			FINAL CROP SUT		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
279	5.311	3	4	2	4	10	2	st3	2	1	4	d2	C	U	T	C	U	T
280	0.940	3	4	2	3	10	2	st3	2	3	4	d2	C	U	I	C	U	T
281	1.594	3	4	2	3	10	2	st3	2	3	4	d2	C	U	I	C	U	T
282	0.805	2	3	3	3	12	1	st3	2	4	4	d1	I	C	U	H	C	U
283	0.910	3	4	2	3	10	2	st3	2	4	4	d2	C	U	T	C	U	T
284	0.337	2	3	2	2	12	2	st3	2	1	4	d1	W	B	T	W	B	T
285	0.432	2	3	2	2	12	2	st3	2	4	4	d1	W	B	T	W	B	T
286	6.439	2	3	2	3	12	2	st3	2	4	4	d1	W	B	T	W	B	T
287	0.601	3	4	2	3	10	2	st3	2	1	4	d2	C	B	U	C	B	U
288	0.369	2	6	4	2	12	2	st1	1	3	1	d4	A	B	C	A	B	C
289	0.634	2	4	2	2	12	2	st3	2	4	4	d1	C	U	O	C	U	H
290	1.265	2	3	4	3	12	2	st3	2	4	4	d1	C	O	U	C	U	T
291	1.114	2	3	4	3	12	1	st3	2	4	4	d1	C	O	U	C	U	B
292	0.388	2	4	4	3	12	1	st3	2	1	4	d1	C	T	L	C	T	L
293	1.059	2	4	4	3	12	1	st3	2	4	4	d1	C	U	T	C	U	T
294	9.169	2	3	2	3	12	2	st3	2	3	4	d1	H	C	U	H	C	U
295	0.428	2	3	2	4	12	2	st3	2	3	4	d1	H	C	U	H	C	U
296	2.818	2	4	3	3	12	1	st3	2	4	4	d1	C	R	L	C	R	L
297	0.435	2	4	4	3	12	1	st3	2	3	4	d1	C	R	L	C	R	L
298	0.229	2	4	2	3	12	1	st3	2	4	4	d1	C	U	N	C	U	N
299	3.469	2	4	3	3	12	2	st3	2	4	4	d1	C	U	L	C	U	L
300	21.199	2	4	2	3	12	2	st3	2	4	4	d1	C	U	N	C	U	N
301	0.550	2	3	2	3	12	2	st3	2	3	4	d1	H	C	U	H	C	U
302	3.569	2	3	3	3	12	2	st3	2	4	4	d1	H	C	U	H	C	U
303	5.883	2	4	3	3	12	2	st3	2	3	4	d1	C	O	U	C	U	B
304	1.187	3	4	4	3	10	2	st3	2	4	4	d2	U	C	L	U	C	L
305	0.665	2	3	3	3	12	2	st3	2	3	4	d1	W	C	T	W	C	T
306	0.303	2	4	3	3	12	2	st3	2	4	4	d1	C	W	T	C	W	T
307	0.771	2	4	2	2	12	2	st3	2	2	4	d1	C	U	N	C	U	N
308	0.815	2	4	2	3	12	2	st3	2	2	4	d1	C	U	N	C	U	N
309	0.458	2	4	3	3	12	1	st3	2	3	4	d1	C	L	U	C	L	U
310	3.903	3	4	2	4	10	2	st3	2	4	4	d2	U	C	L	U	C	L
311	1.160	2	4	1	3	12	2	st3	2	4	4	d1	U	C	T	U	C	T
312	1.778	2	4	2	3	10	2	st3	2	4	4	d1	U	C	T	U	C	T
313	10.103	3	4	2	3	10	2	st3	2	4	4	d2	U	C	T	U	C	T
314	0.673	2	4	2	3	10	1	st3	2	4	4	d1	U	C	T	U	C	T
315	0.312	3	4	4	3	10	1	st3	2	4	4	d2	A	C	B	A	C	B
316	0.464	3	4	2	3	10	2	st3	2	4	4	d2	U	C	T	U	C	T
317	0.314	3	4	2	4	10	2	st3	2	4	4	d2	U	C	T	U	C	T
318	0.594	2	3	2	4	10	2	st3	2	4	4	d1	M	C	U	H	C	U

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
319	0.219	2	3	2	3	10	2	st3	2	3	4	d1	M	C	U	H	C	U
320	0.357	2	3	2	4	12	2	st3	2	4	4	d1	M	C	U	H	C	U
321	0.788	2	3	2	3	10	2	st3	2	4	4	d1	M	C	U	H	C	U
322	0.230	2	6	4	2	12	1	st1	1	1	1	d4	P	B	V	P	B	V
323	0.480	2	3	2	4	9	2	st3	2	4	4	d1	I	H	C	H	C	U
324	7.238	5	5	4	3	10	1	st2	1	1	1	d3	W	V	B	W	V	B
325	2.109	2	4	2	4	12	2	st3	2	4	4	d1	U	C	N	U	C	N
326	0.655	2	4	2	4	12	2	st3	2	4	4	d1	U	C	O	U	C	T
327	2.409	5	5	4	3	10	2	st2	1	1	1	d3	W	V	B	W	V	B
328	1.874	5	5	4	3	10	2	st2	1	1	1	d3	W	V	B	W	V	B
329	0.591	5	5	4	3	10	1	st2	1	4	1	d3	C	B	T	C	B	T
330	1.629	3	4	2	3	10	1	st3	2	1	4	d2	C	R	T	C	R	T
331	2.788	5	5	4	3	10	1	st2	1	1	1	d3	V	B	T	V	B	T
332	4.356	2	4	3	3	10	2	st3	2	4	4	d1	C	U	R	C	U	R
333	1.109	2	4	2	4	9	2	st3	2	4	4	d1	U	C	O	U	C	T
334	14.110	2	4	2	3	12	2	st3	2	4	4	d1	C	U	S	C	U	H
335	0.562	2	4	2	2	12	2	st3	2	1	4	d1	C	R	T	C	R	T
336	3.793	3	4	3	3	10	2	st3	2	4	4	d2	C	U	R	C	U	R
337	0.296	2	3	2	3	9	2	st3	2	4	4	d1	H	C	U	H	C	U
338	3.811	2	4	3	3	10	2	st3	2	3	4	d1	M	C	T	U	C	T
339	4.914	2	4	2	2	12	2	st3	2	4	4	d1	A	C	U	A	C	U
340	0.586	2	4	2	3	12	1	st3	2	4	4	d1	A	C	U	A	C	U
341	7.240	2	4	2	3	9	2	st3	2	4	4	d1	C	U	L	C	U	L
342	2.095	2	3	2	4	12	2	st3	2	4	4	d1	H	C	U	H	C	U
343	2.099	3	4	2	3	10	2	st3	2	1	4	d2	C	B	T	C	B	T
344	1.892	2	4	3	3	9	2	st3	2	3	4	d1	C	U	T	C	U	T
345	1.740	3	4	2	3	10	2	st3	2	3	4	d2	C	U	T	C	U	T
346	3.079	5	5	2	3	9	2	st3	1	4	1	d3	C	U	B	C	U	T
347	2.044	2	4	2	3	12	2	st3	2	3	4	d1	C	U	O	C	U	T
348	3.772	2	4	3	3	12	2	st3	2	3	4	d1	C	U	O	C	U	T
349	5.209	2	4	2	3	12	2	st3	2	3	4	d1	C	U	O	C	U	T
350	0.292	5	5	2	3	9	2	st3	1	3	1	d3	C	U	B	C	U	B
351	0.589	2	6	4	2	12	1	st1	1	4	1	d4	V	B	T	V	B	T
352	0.586	5	5	2	3	10	1	st2	1	1	1	d3	V	B	G	V	B	G
353	0.935	2	4	3	3	10	1	st3	2	4	4	d1	C	U	O	C	U	T
354	1.378	3	4	1	4	10	2	st3	2	3	4	d2	U	C	N	U	C	N
355	0.300	3	4	4	3	10	2	st3	2	1	4	d2	C	L	B	C	L	B
356	0.312	2	3	2	4	12	2	st3	2	3	4	d1	H	I	C	H	C	U
357	0.253	2	3	1	4	9	2	st3	2	3	4	d1	H	I	C	H	C	U
358	0.574	2	3	1	4	12	2	st3	2	3	4	d1	H	I	C	H	C	U

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
359	0.782	2	4	2	4	9	2	st3	2	3	4	d1	U	C	T	U	C	T
360	0.530	5	5	4	2	12	2	st2	1	1	1	d3	V	G	B	V	G	B
361	0.409	2	4	1	4	9	2	st3	2	3	4	d1	U	C	O	U	C	W
362	0.241	2	4	4	3	10	1	st3	2	1	4	d1	B	V	T	B	V	T
363	23.587	2	4	2	3	9	2	st3	2	4	4	d1	C	L	U	C	L	U
364	0.454	2	4	2	2	9	2	st3	2	4	4	d1	C	U	O	C	U	T
365	10.682	5	5	2	2	9	2	st3	1	4	1	d3	C	L	U	C	L	U
366	1.431	2	4	2	2	12	2	st3	2	1	4	d1	C	T	B	C	T	B
367	2.600	2	4	2	3	12	1	st3	2	4	4	d1	U	C	T	U	C	T
368	0.316	2	4	2	4	9	2	st3	2	4	4	d1	U	C	T	U	C	T
369	0.463	2	4	3	4	9	2	st3	2	3	4	d1	C	U	T	C	U	T
370	2.170	2	4	2	4	12	2	st3	2	3	4	d1	U	C	T	U	C	T
371	0.374	2	4	4	3	12	1	st3	2	4	4	d1	A	C	T	A	C	T
372	0.283	5	5	4	2	12	1	st2	1	1	1	d3	V	B	W	V	B	W
373	5.253	3	4	3	3	10	2	st3	2	3	4	d2	C	M	U	C	U	T
374	0.273	2	4	2	3	9	2	st3	2	3	4	d1	C	M	U	C	U	T
375	10.480	2	4	2	3	12	2	st3	2	3	4	d1	U	C	N	U	C	N
376	0.246	2	4	3	3	12	2	st3	2	4	4	d1	C	M	U	C	U	T
377	0.208	5	5	4	3	10	2	st2	1	4	1	d3	V	B	W	V	B	W
378	0.229	2	4	2	3	12	2	st3	2	3	4	d1	U	C	T	U	C	T
379	5.078	2	4	2	3	9	2	st3	2	3	4	d1	U	C	N	U	C	N
380	0.557	2	4	3	4	10	2	st3	2	3	4	d1	C	L	U	C	L	U
381	0.910	3	5	4	3	10	2	st2	2	1	2	d2	A	C	R	A	C	R
382	15.787	3	5	2	3	10	2	st2	2	4	2	d2	C	U	O	C	U	H
383	0.256	3	4	4	3	10	2	st3	2	4	4	d2	A	B	C	A	B	C
384	0.817	2	4	2	4	9	2	st3	2	3	4	d1	C	U	N	C	U	N
385	0.230	2	4	4	3	12	2	st3	2	4	4	d1	W	B	T	W	B	T
386	0.709	2	4	2	3	10	1	st3	2	3	4	d1	C	U	O	C	U	T
387	0.227	2	4	4	3	10	1	st3	2	1	4	d1	A	C	W	A	C	W
388	4.002	3	4	3	3	10	2	st3	2	1	4	d2	C	M	U	C	U	H
389	0.539	2	4	2	4	10	2	st3	2	3	4	d1	U	C	O	U	C	T
390	2.683	2	4	2	3	10	2	st3	2	3	4	d1	U	C	O	U	C	T
391	0.886	5	5	2	3	9	2	st3	1	4	1	d3	C	U	L	C	U	L
392	0.488	2	4	2	3	12	2	st3	2	3	4	d1	U	C	N	U	C	N
393	0.241	2	4	4	3	12	1	st3	2	4	4	d1	A	C	T	A	C	T
394	0.760	2	4	1	4	12	2	st3	2	3	4	d1	H	U	C	H	U	C
395	0.676	5	5	4	3	12	1	st2	2	4	2	d3	A	C	T	A	C	T
396	0.986	5	5	4	3	12	2	st2	2	1	2	d3	A	C	T	A	C	T
397	7.529	2	4	2	4	10	2	st3	2	4	4	d1	C	U	O	C	U	H
398	2.428	5	5	4	3	12	1	st2	2	1	2	d3	V	B	T	V	B	T

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
399	0.413	3	4	4	3	10	2	st3	2	3	4	d2	A	B	C	A	B	C
400	0.233	2	4	2	3	12	1	st3	2	4	4	d1	C	U	T	C	U	T
401	0.457	2	4	2	4	9	2	st3	2	4	4	d1	C	U	O	C	U	N
402	0.462	2	4	2	4	12	2	st3	2	4	4	d1	U	C	O	U	C	T
403	0.888	2	4	2	4	12	2	st3	2	3	4	d1	U	C	T	U	C	T
404	0.790	2	4	2	4	10	2	st3	2	3	4	d1	C	U	L	C	U	L
405	0.291	5	5	4	3	10	2	st2	1	3	1	d3	C	U	O	C	U	T
406	1.018	5	5	2	3	12	2	st2	2	1	2	d3	C	B	T	C	B	T
407	0.429	3	4	3	3	10	1	st3	2	1	4	d2	C	B	T	C	B	T
408	0.943	5	5	4	2	9	1	st3	1	4	1	d3	B	A	C	B	A	C
409	6.215	5	5	4	2	12	1	st2	2	1	2	d3	P	V	B	P	V	B
410	0.488	5	5	2	3	10	1	st2	1	1	1	d3	B	C	T	B	C	T
411	11.511	2	4	2	3	10	2	st3	2	4	4	d1	U	C	O	U	C	H
412	0.230	5	5	3	3	10	1	st2	1	1	1	d3	R	B	C	R	B	C
413	0.398	2	4	3	4	10	2	st3	2	4	4	d1	C	L	U	C	L	U
414	0.820	5	5	2	3	9	2	st3	1	4	1	d3	C	L	U	C	L	U
415	0.775	2	4	1	4	9	2	st3	2	4	4	d1	H	U	C	H	U	C
416	0.670	2	4	1	3	9	2	st3	2	4	4	d1	H	U	C	H	U	C
417	0.962	2	4	2	3	12	2	st3	2	3	4	d1	U	C	O	U	C	T
418	6.260	2	4	2	3	9	2	st3	2	4	4	d1	U	C	N	U	C	N
419	0.500	2	4	2	3	10	1	st3	2	4	4	d1	C	U	O	C	U	H
420	0.335	5	5	2	2	9	2	st3	1	4	1	d3	C	U	L	C	U	L
421	0.472	5	5	4	3	10	2	st2	1	1	1	d3	V	G	B	V	G	B
422	0.221	5	5	4	2	9	2	st3	1	4	1	d3	B	A	C	B	A	C
423	0.554	2	4	2	4	9	2	st3	2	4	4	d1	C	U	O	C	U	T
424	3.618	2	4	2	3	9	2	st3	2	3	4	d1	C	U	O	C	U	N
425	2.408	2	4	2	3	12	2	st3	2	3	4	d1	U	C	N	U	C	N
426	0.318	2	4	2	3	12	2	st3	2	1	4	d1	A	C	U	A	C	U
427	0.599	5	5	2	3	10	1	st2	1	1	1	d3	A	C	B	A	C	B
428	1.126	2	4	3	3	12	1	st3	2	4	4	d1	C	U	L	C	U	L
429	0.276	2	4	2	3	12	1	st3	2	4	4	d1	C	U	L	C	U	L
430	1.639	5	3	2	3	12	2	st4	3	4	4	d1	H	U	C	H	U	C
431	0.243	3	4	4	3	10	2	st3	2	1	4	d2	A	B	T	A	B	T
432	1.298	2	4	2	3	9	1	st3	2	4	4	d1	C	U	N	C	U	N
433	0.506	2	4	1	4	10	2	st3	2	4	4	d1	C	U	L	C	U	L
434	0.456	2	4	1	3	10	2	st3	2	4	4	d1	U	C	O	U	C	T
435	0.617	2	4	1	3	9	2	st3	2	4	4	d1	U	C	O	U	C	T
436	0.483	3	6	4	3	9	1	st1	1	1	1	d4	P	B	V	P	B	V
437	0.256	3	4	4	3	10	1	st3	2	1	4	d2	G	B	V	G	B	V
438	1.849	3	6	4	2	9	1	st1	1	1	1	d4	P	V	B	P	V	B

Table 35 (Contd...)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
439	4.311	2	6	4	3	10	1	st1	1	1	1	d4	P	V	B	P	V	B
440	0.927	2	4	2	2	12	2	st3	2	1	4	d1	A	C	B	A	C	B
441	3.799	5	3	2	3	12	2	st4	3	3	4	d1	H	I	C	H	C	U
442	3.958	5	3	2	3	9	2	st4	3	4	4	d1	H	I	C	H	C	U
443	0.834	2	4	3	3	12	2	st3	2	4	4	d1	C	U	N	C	U	N
444	1.872	2	4	3	3	12	2	st3	2	3	4	d1	U	C	N	U	C	N
445	0.628	2	6	4	3	10	1	st1	1	1	1	d4	P	V	B	P	V	B
446	0.947	3	5	4	3	10	2	st2	2	4	2	d2	U	C	O	U	C	N
447	8.338	5	3	2	3	9	2	st4	3	3	4	d1	I	H	C	H	C	U
448	0.994	5	3	2	3	9	2	st4	3	3	4	d1	I	H	C	H	C	U
449	0.589	2	4	2	2	9	2	st3	2	4	4	d1	C	U	L	C	U	L
450	0.764	2	4	2	3	10	1	st3	2	3	4	d1	C	L	U	C	L	U
451	0.387	3	5	2	3	10	1	st2	2	4	2	d2	C	L	U	C	L	U
452	0.241	2	4	2	3	10	2	st3	2	4	4	d1	C	U	O	C	U	T
453	0.974	5	5	2	3	9	2	st3	1	4	1	d3	B	A	C	B	A	C
454	1.822	2	4	2	4	10	2	st3	2	4	4	d1	U	C	O	U	C	T
455	0.252	5	3	2	3	9	2	st4	3	4	4	d1	I	H	C	H	C	U
456	3.920	2	5	2	3	10	2	st3	2	4	4	d1	C	U	O	C	U	N
457	16.662	3	6	4	2	9	1	st1	1	1	1	d4	P	B	V	P	B	V
458	0.221	5	5	4	3	12	1	st2	2	4	2	d3	A	C	B	A	C	B
459	1.665	2	3	3	3	12	2	st3	3	4	4	d1	H	C	U	H	C	U
460	0.220	2	3	3	3	12	1	st3	3	4	4	d1	A	C	U	A	C	U
461	0.624	2	3	4	3	12	1	st3	3	4	4	d1	A	C	U	A	C	U
462	0.237	2	4	4	2	12	1	st3	2	1	4	d1	A	C	B	A	C	B
463	0.557	2	4	2	3	10	2	st3	2	3	4	d1	C	U	T	C	U	T
464	0.524	5	5	2	3	9	2	st3	1	4	1	d3	C	T	U	C	T	U
465	0.369	5	5	4	2	12	2	st2	2	1	2	d3	A	C	B	A	C	B
466	3.029	2	4	2	3	12	2	st3	2	3	4	d1	C	U	O	C	U	H
467	0.266	2	4	2	4	9	2	st3	2	4	4	d1	C	U	T	C	U	T
468	8.839	2	5	2	3	10	2	st3	2	3	4	d1	C	U	O	C	U	N
469	6.870	2	4	3	3	10	2	st3	2	3	4	d1	C	U	T	C	U	T
470	0.331	2	4	1	4	10	2	st3	2	4	4	d1	H	C	U	H	C	U
471	0.336	2	6	4	3	10	1	st1	1	1	1	d4	P	V	B	P	V	B
472	0.835	2	4	1	4	9	2	st3	2	4	4	d1	U	C	O	U	C	T
473	0.343	2	4	1	3	10	2	st3	2	4	4	d1	H	C	U	H	C	U
474	1.241	2	4	2	3	9	2	st3	2	3	4	d1	C	U	O	C	U	N
475	1.235	2	4	2	3	9	2	st3	2	4	4	d1	C	U	O	C	U	H
476	0.933	2	5	4	3	10	2	st3	2	1	4	d1	C	B	U	C	B	U
477	1.491	2	4	2	3	10	2	st3	2	3	4	d1	C	U	O	C	U	T
478	0.342	3	6	4	2	9	1	st1	1	4	1	d4	B	A	C	B	A	C

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
479	0.395	2	4	1	3	10	2	st3	2	4	4	d1	U	C	O	U	C	N
480	0.434	2	4	1	3	9	2	st3	2	4	4	d1	U	C	O	U	C	T
481	11.403	2	5	4	3	10	1	st2	1	1	1	d3	W	V	B	W	V	B
482	1.295	2	5	3	3	10	2	st2	1	3	1	d3	C	T	B	C	T	B
483	0.315	5	5	4	2	9	2	st3	1	4	1	d3	B	A	C	B	A	C
484	4.384	2	4	2	2	9	2	st3	2	4	4	d1	C	U	O	C	U	H
485	0.408	2	3	2	3	12	1	st3	3	4	4	d1	H	U	C	H	U	C
486	2.441	2	4	3	3	10	2	st3	2	4	4	d1	C	U	O	C	U	N
487	0.696	2	5	4	3	10	2	st2	1	1	1	d3	V	B	T	V	B	T
488	2.447	2	3	2	3	12	2	st3	3	4	4	d1	H	U	C	H	U	C
489	3.860	5	5	2	3	9	2	st2	1	4	2	d3	C	L	U	C	L	U
490	0.565	3	6	4	2	9	1	st1	1	1	1	d4	P	V	B	P	V	B
491	0.401	5	5	2	3	9	2	st2	1	3	2	d3	C	L	U	C	L	U
492	1.232	2	4	3	3	9	2	st3	2	4	4	d1	C	U	O	C	U	T
493	0.315	5	5	4	2	9	2	st3	1	4	1	d3	A	B	V	A	B	V
494	1.732	2	5	2	4	10	2	st3	2	3	4	d1	U	C	O	U	C	T
495	0.358	2	4	2	3	9	2	st3	2	3	4	d1	U	C	O	U	C	T
496	0.522	2	4	2	2	9	2	st3	2	4	4	d1	C	L	U	C	L	U
497	2.179	2	5	3	3	10	2	st3	2	4	4	d1	C	U	O	C	U	H
498	0.959	5	5	4	2	9	1	st2	1	1	2	d3	V	B	T	V	B	T
499	0.292	5	5	2	2	9	1	st2	1	4	2	d3	B	A	C	B	A	C
500	1.030	5	5	2	3	9	1	st2	1	4	2	d3	B	A	C	B	A	C
501	0.395	2	5	3	3	10	2	st2	1	4	1	d3	C	U	T	C	U	T
502	1.443	5	3	2	2	12	2	st3	3	4	4	d1	H	C	U	H	C	U
503	0.433	5	5	2	2	9	2	st2	1	4	2	d3	A	B	C	A	B	C
504	0.325	3	6	4	3	9	1	st1	1	1	1	d4	P	V	B	P	V	B
505	2.494	5	5	2	3	9	2	st2	1	4	2	d3	A	B	C	A	B	C
506	0.447	5	5	2	3	9	1	st2	1	1	2	d3	B	A	C	B	A	C
507	0.463	5	3	2	3	12	1	st3	3	4	4	d1	I	C	U	H	C	U
508	0.853	5	3	4	2	12	1	st3	3	1	4	d1	B	W	T	B	W	T
509	1.702	2	5	4	2	9	1	st2	1	1	1	d3	W	V	B	W	V	B
510	2.068	5	3	2	3	12	2	st3	3	4	4	d1	H	C	U	H	C	U
511	2.575	5	5	2	3	12	2	st2	1	4	2	d3	C	U	T	C	U	T
512	3.749	2	5	3	3	10	2	st3	2	3	4	d1	C	U	O	C	U	H
513	6.385	2	3	2	3	9	2	st4	3	4	4	d1	H	C	U	H	C	U
514	6.811	2	3	2	3	9	2	st4	3	3	4	d1	H	C	U	H	C	U
515	6.383	5	5	2	3	9	2	st2	1	4	2	d3	C	L	U	C	L	U
516	0.566	2	4	2	3	10	1	st3	2	4	4	d2	A	B	T	A	B	T
517	0.654	2	4	4	3	10	1	st3	2	1	4	d2	A	B	T	A	B	T
518	7.476	2	3	2	3	9	2	st4	3	4	4	d1	H	C	U	H	C	U

Table 35 (Contd...)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
519	0.445	2	3	2	2	9	2	st4	3	4	4	d1	H	C	U	H	C	U
520	1.246	2	4	2	3	9	2	st3	2	4	4	d2	C	U	O	C	U	N
521	7.367	2	4	2	3	10	2	st3	2	4	4	d2	C	U	O	C	U	H
522	5.599	2	4	3	3	10	2	st3	2	3	4	d2	C	L	U	C	L	U
523	1.421	2	4	3	3	10	2	st3	2	4	4	d2	C	L	U	C	L	U
524	3.922	5	3	2	3	12	2	st3	3	3	4	d1	H	C	U	H	C	U
525	0.589	5	5	4	2	9	1	st2	1	1	2	d3	V	B	T	V	B	T
526	0.535	5	5	2	2	9	1	st2	1	1	2	d3	V	B	T	V	B	T
527	0.356	5	3	2	2	12	2	st3	3	4	4	d1	H	C	U	H	C	U
528	0.653	5	5	2	3	9	1	st2	1	4	2	d3	A	B	C	A	B	C
529	5.597	2	3	2	3	9	2	st4	3	4	4	d1	H	I	C	H	C	U
530	0.373	5	3	3	2	12	2	st3	3	4	4	d1	H	C	U	H	C	U
531	0.353	5	3	3	2	12	1	st3	3	4	4	d1	H	C	U	H	C	U
532	1.036	5	5	2	2	12	2	st2	1	4	2	d3	C	U	T	C	U	T
533	0.379	5	5	2	2	9	2	st2	1	4	2	d3	C	U	T	C	U	T
534	5.240	2	3	2	3	9	2	st3	2	4	4	d1	H	C	U	H	C	U
535	0.504	5	3	3	3	12	2	st3	3	4	4	d1	H	I	C	H	C	T
536	9.439	5	3	2	3	12	2	st3	3	4	4	d1	H	I	C	H	C	U
537	0.311	5	5	2	2	12	1	st2	1	4	2	d3	C	L	U	C	L	U
538	0.241	5	5	3	2	12	1	st2	1	4	2	d3	C	L	U	C	L	U
539	2.078	2	5	2	4	10	2	st3	2	3	4	d1	C	U	O	C	U	L
540	12.431	2	3	2	3	8	2	st3	2	4	4	d1	H	C	U	H	C	U
541	0.369	5	5	2	2	12	1	st2	1	4	2	d3	C	U	N	C	U	N
542	0.928	2	3	2	2	8	2	st3	2	4	4	d1	H	C	U	H	C	U
543	0.243	2	4	2	2	12	1	st3	2	4	4	d1	C	U	N	C	U	N
544	1.597	2	4	2	3	10	2	st3	2	3	4	d2	C	U	O	C	U	T
545	0.273	5	5	3	3	12	2	st2	1	4	2	d3	C	U	N	C	U	N
546	3.450	2	4	2	4	10	2	st3	2	4	4	d2	C	U	O	C	U	N
547	0.871	2	3	2	3	12	2	st3	2	4	4	d1	H	I	U	H	C	U
548	0.251	2	4	2	4	9	2	st3	2	4	4	d2	C	U	O	C	U	T
549	0.878	5	5	2	3	12	2	st2	1	4	2	d3	C	U	T	C	U	T
550	3.428	2	3	2	2	8	1	st3	2	4	4	d1	H	C	U	H	C	U
551	0.712	2	3	2	4	9	2	st3	2	4	4	d1	H	C	U	H	C	U
552	0.255	2	3	2	4	9	2	st4	3	4	4	d1	H	I	C	H	C	U
553	1.669	2	3	2	4	9	2	st4	3	4	4	d1	H	I	C	H	C	U
554	0.389	2	3	2	2	8	2	st3	2	4	4	d1	H	I	C	H	C	U
555	0.410	2	5	2	4	10	2	st3	2	3	4	d1	C	O	U	C	U	L
556	0.800	2	4	2	4	10	2	st3	2	3	4	d2	C	U	O	C	U	N
557	2.238	2	3	2	3	8	2	st3	2	4	4	d1	H	U	C	H	U	C
558	1.684	2	4	2	4	7	2	st3	2	4	4	d2	C	H	O	C	H	U

Table 35 (Contd...)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
559	0.223	2	3	2	3	9	3	st4	3	4	4	d1	H	C	U	H	C	U
560	4.290	2	3	2	4	9	3	st4	3	4	4	d1	H	C	U	H	C	U
561	0.752	2	3	2	4	9	2	st4	3	4	4	d1	H	C	U	H	C	U
562	1.877	2	5	2	4	7	2	st3	2	3	4	d1	C	M	U	C	U	N
563	13.447	2	5	2	3	7	2	st3	2	3	4	d1	C	U	T	C	U	T
564	1.244	2	5	1	4	7	2	st3	2	3	4	d1	C	M	U	C	U	N
565	0.351	5	5	2	3	8	2	st2	1	4	2	d3	C	U	T	C	U	T
566	0.793	2	3	2	3	7	2	st4	3	4	4	d1	H	C	U	H	C	U
567	0.346	2	3	2	4	8	2	st3	2	4	4	d1	H	U	C	H	U	C
568	0.251	2	3	2	3	9	3	st4	3	4	4	d1	H	C	U	H	C	U
569	22.066	2	4	2	3	7	2	st3	2	4	4	d2	C	U	O	C	U	H
570	0.857	2	5	1	3	7	2	st3	2	3	4	d1	C	M	U	C	U	T
571	7.666	5	3	2	3	8	2	st3	3	4	4	d1	H	U	C	H	U	C
572	4.748	2	3	2	2	8	2	st3	2	4	4	d1	H	C	U	H	C	U
573	0.364	2	4	1	4	10	2	st3	2	4	4	d2	U	C	O	U	C	N
574	0.470	2	4	2	4	7	2	st3	2	4	4	d2	U	C	O	U	C	N
575	1.190	2	3	2	4	9	3	st4	3	4	4	d1	I	C	M	H	C	U
576	0.614	5	3	2	4	12	2	st3	3	4	4	d1	I	C	M	H	C	U
577	10.283	2	5	2	3	7	2	st3	2	4	4	d1	C	U	O	C	U	N
578	0.369	5	3	2	4	12	2	st3	3	4	4	d1	I	C	M	H	C	U
579	0.412	2	4	1	4	7	2	st3	2	4	4	d2	U	C	O	U	C	T
580	1.126	2	3	2	3	9	2	st3	3	4	4	d1	I	M	C	H	U	C
581	0.400	2	3	2	3	9	3	st3	3	4	4	d1	I	M	C	H	U	C
582	0.303	2	4	1	3	7	2	st3	2	4	4	d2	U	C	O	U	C	T
583	1.272	2	3	2	4	9	3	st3	3	4	4	d1	I	M	C	H	C	U
584	0.797	2	3	2	4	9	2	st4	3	4	4	d1	I	M	C	H	C	U
585	1.241	2	3	1	3	8	2	st3	2	4	4	d1	H	U	C	H	U	C
586	0.426	2	3	2	4	9	2	st3	2	4	4	d1	I	M	C	H	C	U
587	0.218	2	3	1	4	8	2	st3	2	4	4	d1	H	U	C	H	U	C
588	0.766	2	3	2	3	7	2	st3	3	4	4	d1	H	U	C	H	U	C
589	0.960	2	3	2	4	9	3	st3	3	5	4	d1	H	U	C	H	U	C
590	0.280	2	3	2	4	9	3	st3	3	4	4	d1	H	U	C	H	U	C
591	0.749	2	3	2	5	9	3	st3	3	4	4	d1	H	U	C	H	U	C
592	0.572	2	3	2	4	7	2	st3	3	5	4	d1	H	U	C	H	U	C
593	0.499	2	3	2	5	9	3	st4	3	4	4	d1	H	U	O	H	U	C
594	0.645	2	3	2	4	9	3	st4	3	5	4	d1	H	U	C	H	U	C
595	1.227	2	3	2	5	9	3	st3	3	5	4	d1	H	U	C	H	U	C
596	0.280	2	3	2	2	7	2	st3	3	4	4	d1	H	U	C	H	U	C
597	0.348	2	3	1	5	8	3	st4	3	4	4	d1	H	U	O	H	U	C
598	0.500	2	3	2	4	8	3	st4	3	4	4	d1	H	U	O	H	U	C

Table 35 (Contd...)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
599	1.204	2	3	2	4	9	3	st3	3	5	4	d1	H	U	C	H	U	C
600	0.283	2	3	1	4	8	3	st4	3	4	4	d1	H	U	O	H	U	C
601	0.428	2	3	2	4	8	2	st3	2	4	4	d1	H	U	O	H	U	C
602	0.434	2	3	2	5	9	3	st4	3	5	4	d1	H	U	C	H	U	C
603	2.378	2	4	2	2	7	2	st3	2	4	4	d2	C	U	T	C	U	T
604	0.215	2	3	3	2	7	2	st3	3	4	4	d1	I	C	U	C	U	N
605	8.798	2	4	3	2	7	2	st3	2	4	4	d2	C	U	N	C	U	N
606	0.463	2	3	1	4	8	2	st4	3	4	4	d1	H	U	O	H	U	C
607	4.080	2	3	2	4	7	3	st3	3	6	4	d1	H	U	M	H	U	C
608	0.354	2	3	2	4	7	2	st3	3	6	4	d1	H	U	M	H	U	C
609	1.000	2	3	2	4	8	3	st4	3	5	4	d1	H	U	M	H	U	C
610	0.567	3	5	4	2	7	2	st1	1	1	2	d3	P	V	B	P	V	B
611	1.780	2	3	2	5	7	3	st3	3	5	4	d1	H	U	M	H	U	C
612	0.655	2	3	2	3	7	2	st3	3	6	4	d1	H	U	C	H	U	C
613	2.138	2	3	2	3	8	3	st4	3	5	4	d1	H	U	C	H	U	C
614	0.346	2	3	2	5	9	3	st4	3	6	4	d1	H	U	O	H	U	C
615	0.373	2	3	2	4	8	3	st4	3	6	4	d1	H	U	O	H	U	C
616	1.782	2	3	2	3	8	2	st4	3	5	4	d1	H	U	C	H	U	C
617	9.845	3	5	4	2	7	1	st1	1	1	2	d3	P	V	B	P	V	B
618	0.396	2	4	4	2	7	2	st3	2	1	4	d2	V	B	T	V	B	T
619	0.742	2	3	2	3	8	2	st3	2	5	4	d1	H	U	C	H	U	C
620	2.189	5	3	2	2	8	2	st3	3	4	4	d1	H	U	C	H	U	C
621	3.873	2	4	2	3	7	2	st3	2	3	4	d2	C	L	U	C	L	U
622	0.499	2	3	2	4	7	3	st4	3	6	4	d1	H	U	M	H	U	C
623	0.450	3	5	4	2	7	1	st1	1	4	2	d3	V	G	B	V	G	B
624	0.792	2	3	2	4	7	3	st3	3	5	4	d1	H	U	M	H	U	C
625	0.940	2	3	2	3	7	1	st3	3	4	4	d1	W	C	T	W	C	T
626	0.476	2	3	2	4	7	2	st3	3	4	4	d1	H	C	U	H	C	U
627	0.268	2	3	2	2	8	2	st3	2	5	4	d1	H	U	C	H	U	C
628	3.541	2	3	2	2	8	2	st3	2	2	4	d1	W	C	T	W	C	T
629	7.591	2	3	2	3	7	2	st3	3	4	4	d1	H	U	O	H	U	C
630	0.325	2	3	2	3	7	3	st4	3	6	4	d1	H	U	M	H	U	C
631	0.204	2	3	2	2	8	2	st3	2	2	4	d1	W	C	T	W	C	T
632	0.234	2	3	2	3	7	3	st4	3	5	4	d1	H	U	M	H	U	C
633	0.209	2	3	2	2	8	2	st3	2	4	4	d1	H	U	O	H	U	C
634	2.062	5	5	4	2	8	2	st2	1	2	1	d3	B	V	T	B	V	T
635	0.522	2	3	2	3	7	3	st3	3	6	4	d1	H	U	M	H	U	C
636	0.502	2	3	2	2	8	2	st4	3	2	4	d1	H	C	U	H	C	U
637	4.799	2	3	3	3	8	2	st4	3	3	4	d1	H	C	U	H	C	U
638	0.237	5	5	2	2	8	2	st2	1	2	1	d3	C	U	L	C	U	L

Table 35 (Contd...)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
639	0.614	5	5	2	2	8	2	st2	1	2	1	d3	C	U	L	C	U	L
640	0.567	2	3	2	3	8	2	st4	3	3	4	d1	H	U	M	H	U	C
641	0.892	2	5	2	3	7	2	st3	2	3	4	d1	C	U	N	C	U	N
642	0.839	2	4	3	2	7	2	st3	2	1	4	d2	C	U	L	C	U	L
643	1.740	5	5	4	3	8	2	st2	1	2	1	d3	B	V	T	B	V	T
644	0.501	2	3	2	3	7	2	st3	3	6	4	d1	H	U	M	H	U	C
645	1.020	2	3	2	3	7	2	st4	3	5	4	d1	H	U	M	H	U	C
646	1.186	2	5	2	3	6	2	st3	2	3	4	d1	C	U	L	C	U	L
647	10.232	2	2	2	3	7	2	st4	4	4	4	d1	I	H	C	H	C	U
648	0.325	2	3	2	2	8	1	st3	2	2	4	d1	H	C	U	H	C	U
649	0.481	2	3	2	3	7	2	st4	3	3	4	d1	H	C	O	H	C	U
650	1.052	2	3	2	3	7	2	st3	3	5	4	d1	H	U	O	H	U	U
651	0.220	2	3	2	4	7	2	st3	3	4	4	d1	H	C	U	H	C	U
652	0.447	5	3	2	2	8	2	st3	3	2	4	d1	H	C	U	H	C	U
653	0.542	2	3	2	2	7	2	st3	3	5	4	d1	H	U	O	H	U	C
654	0.335	5	5	4	2	8	2	st2	1	2	1	d3	B	V	T	B	V	T
655	0.251	5	5	4	3	8	2	st2	1	2	1	d3	B	V	T	B	V	T
656	0.252	5	3	1	3	8	2	st3	3	4	4	d1	H	U	C	H	U	C
657	0.306	5	5	3	3	8	2	st2	1	4	1	d3	A	C	B	A	C	B
658	0.829	5	5	2	2	8	2	st2	1	4	1	d3	A	C	B	A	C	B
659	0.221	5	5	4	3	8	2	st2	1	3	1	d3	B	V	C	B	V	C
660	1.525	2	3	3	3	8	2	st4	3	4	4	d1	H	C	U	H	C	U
661	0.438	5	3	1	3	8	2	st3	3	3	4	d1	H	U	C	H	U	C
662	1.520	5	3	2	2	8	2	st3	3	4	4	d1	H	U	C	H	U	C
663	1.501	5	3	2	3	8	2	st3	3	3	4	d1	H	U	C	H	U	C
664	0.631	2	3	2	2	7	2	st4	3	5	4	d1	H	I	U	H	U	C
665	0.351	2	3	2	2	7	1	st3	3	4	4	d1	H	I	C	H	C	U
666	0.719	3	5	4	3	7	2	st1	1	1	2	d3	V	B	T	V	B	T
667	2.922	3	5	4	3	7	1	st1	1	1	2	d3	V	B	T	V	B	T
668	0.331	2	5	2	3	7	2	st3	2	1	4	d1	A	B	T	A	B	T
669	0.300	2	4	3	3	7	1	st3	2	1	4	d2	A	B	T	A	B	T
670	1.334	2	3	2	3	8	2	st4	3	4	4	d1	H	C	U	H	C	U
671	1.742	2	3	2	3	7	2	st4	3	4	4	d1	H	C	U	H	C	U
672	2.984	3	5	2	3	6	2	st3	2	3	2	d2	C	U	L	C	U	L
673	4.576	2	3	2	2	7	2	st4	3	4	4	d1	H	U	C	H	U	C
674	0.311	2	4	3	3	7	1	st3	2	4	4	d2	C	U	L	C	U	L
675	2.455	3	5	2	3	7	2	st3	2	3	2	d2	C	U	N	C	U	N
676	2.128	2	3	2	2	7	2	st3	3	4	4	d1	H	C	U	H	C	U
677	1.031	2	4	3	3	7	2	st3	2	4	4	d2	C	U	O	C	U	N
678	0.355	2	3	2	2	7	2	st4	3	4	4	d1	H	C	U	H	C	U

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIO-PHYSICAL FACTORS*										INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
679	2.350	2	3	2	2	8	2	st4	3	4	4	d1	H	C	U	H	C	U
680	0.884	2	3	3	3	8	2	st4	3	4	4	d1	I	H	C	H	C	U
681	1.212	2	4	2	2	7	2	st3	2	4	4	d2	C	U	N	C	U	N
682	5.999	3	5	2	3	7	2	st3	2	4	2	d2	C	U	O	C	U	N
683	1.206	2	3	2	2	8	2	st4	3	4	4	d1	H	U	C	H	U	C
684	3.020	2	2	2	2	7	2	st4	4	4	4	d1	H	C	U	H	C	U
685	0.259	3	5	2	3	6	2	st3	2	2	2	d2	C	U	L	C	U	L
686	0.238	2	3	3	2	8	2	st4	3	3	4	d1	H	C	U	H	C	U
687	0.466	2	3	2	2	7	2	st3	3	4	4	d1	H	C	U	H	C	U
688	0.282	3	5	4	2	7	2	st1	1	1	2	d3	V	B	T	V	B	T
689	1.873	5	5	2	2	7	2	st2	1	4	1	d1	C	U	L	C	U	L
690	0.324	3	4	4	2	7	1	st1	1	4	1	d4	V	B	T	V	B	T
691	5.603	3	4	4	2	7	1	st1	1	1	1	d4	P	B	V	P	B	V
692	0.489	3	5	3	3	7	1	st1	1	1	2	d3	B	C	R	B	C	R
693	2.648	2	4	2	3	7	2	st3	2	3	4	d2	C	U	N	C	U	N
694	0.632	3	5	4	2	7	2	st1	1	4	2	d3	A	C	U	A	C	U
695	1.059	3	5	4	3	7	2	st1	1	1	2	d3	V	B	T	V	B	T
696	0.581	2	4	4	2	7	2	st3	2	4	4	d2	A	C	O	A	C	U
697	1.397	4	5	2	3	6	2	st2	2	2	2	d2	C	U	T	C	U	T
698	0.567	2	2	2	2	7	1	st4	4	4	4	d1	H	I	U	H	U	C
699	0.565	4	5	2	3	6	2	st2	2	3	2	d2	C	U	T	C	U	T
700	0.280	2	3	3	2	8	2	st4	3	4	4	d1	H	I	U	H	U	C
701	0.301	2	3	3	2	8	2	st4	3	3	4	d1	H	I	U	H	U	C
702	0.487	2	3	2	2	7	2	st4	3	3	4	d1	H	I	U	H	U	C
703	1.866	2	3	2	2	8	2	st4	3	3	4	d1	H	I	U	H	U	C
704	15.038	2	5	2	3	6	2	st3	2	2	2	d2	C	U	T	C	U	T
705	0.295	3	4	4	2	7	1	st1	1	4	1	d4	B	A	C	B	A	C
706	1.790	2	4	2	2	7	2	st5	2	4	1	d1	H	M	U	H	U	C
707	8.436	2	4	2	3	7	2	st5	2	4	1	d1	H	M	U	H	U	C
708	0.819	2	4	2	3	7	1	st5	2	4	1	d1	H	M	U	H	U	C
709	2.040	4	5	2	3	7	2	st2	2	3	2	d2	C	U	T	C	U	T
710	1.213	4	5	2	3	6	2	st2	2	4	2	d2	C	U	O	C	U	N
711	2.727	2	5	2	3	6	2	st2	2	4	2	d3	C	U	O	C	U	N
712	1.149	2	5	2	3	6	2	st3	2	4	2	d2	C	U	O	C	U	N
713	0.442	2	4	2	2	7	1	st5	2	4	1	d1	C	B	U	C	B	U
714	0.342	2	4	3	2	7	1	st3	2	4	4	d2	A	B	T	A	B	T
715	0.492	2	4	2	2	7	2	st5	2	3	1	d1	H	M	C	H	C	U
716	3.553	2	4	2	2	7	2	st5	2	4	1	d1	H	M	C	H	C	U
717	3.029	2	4	2	3	7	2	st5	2	3	1	d1	C	U	N	C	U	N
718	0.510	3	5	4	2	7	1	st1	1	4	2	d3	A	B	V	A	B	V

Table 35 (Contd...)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
719	1.039	2	4	1	3	7	2	st5	2	4	1	d1	C	U	H	C	U	H
720	1.253	2	5	2	2	6	2	st3	2	4	2	d2	C	U	T	C	U	T
721	1.045	4	5	2	4	6	2	st2	2	4	2	d2	C	U	R	C	U	R
722	3.500	3	5	2	3	7	2	st3	2	4	2	d2	C	B	T	C	B	T
723	1.002	4	5	2	4	7	2	st2	2	4	2	d2	C	U	T	C	U	T
724	0.410	3	5	2	3	7	2	st3	2	1	2	d2	C	B	R	C	B	R
725	1.800	3	5	2	3	7	2	st3	2	3	2	d2	C	B	T	C	B	T
726	0.218	2	4	1	3	6	2	st5	2	4	1	d1	H	M	C	H	C	U
727	1.638	2	4	2	3	6	2	st5	2	3	1	d1	H	M	C	H	C	U
728	0.683	3	5	2	3	6	2	st3	2	3	2	d2	C	U	T	C	U	T
729	14.402	2	4	2	2	2	2	st5	2	4	1	d1	U	C	H	U	C	H
730	0.632	2	4	2	3	7	2	st5	2	3	1	d1	H	M	C	H	C	U
731	0.805	3	5	2	2	7	2	st3	2	1	2	d2	C	B	T	C	B	T
732	0.543	4	5	2	3	6	2	st2	2	4	2	d2	C	U	T	C	U	T
733	2.025	2	5	2	2	6	2	st2	2	4	2	d3	C	U	L	C	U	L
734	0.354	2	4	2	3	2	2	st5	2	3	1	d1	H	M	C	H	C	U
735	17.278	2	4	2	3	2	2	st5	2	4	1	d1	H	M	C	H	C	U
736	1.407	4	5	2	4	7	2	st2	2	4	2	d2	C	U	N	C	U	N
737	0.899	3	5	2	3	7	2	st3	2	1	2	d2	C	B	V	C	B	V
738	0.231	4	5	2	3	7	4	st2	2	3	2	d2	H	M	U	H	U	C
739	0.637	4	5	2	4	7	4	st2	2	3	2	d2	H	M	U	H	U	C
740	0.360	2	4	2	3	2	4	st5	2	4	1	d1	H	M	U	H	U	C
741	2.409	4	5	2	3	6	2	st2	2	3	2	d2	C	U	W	C	U	W
742	3.293	4	5	2	3	6	2	st2	2	4	2	d2	C	U	O	C	U	N
743	1.028	4	5	2	3	7	2	st2	2	3	2	d2	C	U	W	C	U	W
744	0.481	4	5	2	3	7	4	st2	2	4	2	d2	H	M	U	H	U	C
745	0.322	3	5	2	2	7	4	st3	2	1	2	d2	H	M	U	H	U	C
746	0.840	4	5	2	2	6	2	st2	2	4	2	d2	C	U	T	C	U	T
747	0.428	4	5	2	3	7	2	st2	2	4	2	d2	C	U	T	C	U	T
748	0.459	4	5	2	4	6	2	st2	2	4	2	d2	C	U	T	C	U	T
749	1.151	2	5	2	3	6	2	st2	2	4	2	d3	C	U	T	C	U	T
750	0.249	3	5	2	3	6	2	st3	2	4	2	d2	C	U	W	C	U	W
751	0.462	2	4	2	3	2	2	st3	2	4	4	d2	U	C	O	U	C	N
752	2.917	2	3	2	3	6	2	st5	2	4	4	d1	H	M	C	H	U	C
753	20.370	2	4	2	3	6	2	st3	2	4	4	d2	U	C	O	U	C	N
754	0.365	2	5	2	2	6	2	st2	2	1	2	d3	C	U	W	C	U	W
755	1.540	4	5	2	3	6	2	st2	2	4	2	d2	C	U	O	C	U	N
756	0.419	2	5	4	2	6	2	st2	2	1	2	d3	C	U	W	C	U	W
757	2.237	2	5	4	2	6	1	st2	2	1	2	d3	C	U	W	C	U	W

Table 35 (Contd...)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
758	0.335	4	5	2	2	6	4	st2	2	1	2	d2	H	M	U	H	U	C
759	1.329	4	5	2	2	6	2	st2	2	1	2	d2	C	U	W	C	U	W
760	0.256	4	5	2	3	6	2	st2	2	1	2	d2	C	U	W	C	U	W
761	6.510	2	4	2	2	6	2	st3	2	4	4	d2	C	U	T	C	U	T
762	0.325	2	4	2	4	2	2	st5	2	4	1	d1	H	M	C	H	C	U
763	0.316	2	5	2	3	6	2	st2	2	2	2	d3	C	U	T	C	U	T
764	1.057	4	5	2	3	6	4	st2	2	4	2	d2	H	M	U	H	U	C
765	0.995	4	5	2	3	6	2	st2	2	4	2	d2	C	U	T	C	U	T
766	0.528	4	5	2	3	6	4	st2	2	4	2	d2	H	M	U	H	U	C
767	0.710	2	4	2	4	2	2	st5	2	4	1	d1	U	C	M	U	C	T
768	0.303	4	5	2	2	6	2	st2	2	4	2	d2	C	U	W	C	U	W
769	1.592	2	4	1	3	2	2	st5	2	4	1	d1	U	C	M	U	C	T
770	11.193	2	4	2	3	6	2	st3	2	4	4	d2	U	C	O	U	C	N
771	0.248	2	4	2	3	6	1	st3	2	4	4	d2	A	C	U	A	C	U
772	0.873	2	4	4	2	6	2	st3	2	4	4	d2	A	C	U	A	C	U
773	1.593	2	4	4	2	6	1	st3	2	4	4	d2	A	C	U	A	C	U
774	3.403	2	3	3	2	6	2	st5	2	2	4	d1	H	C	U	H	C	U
775	0.921	3	6	3	2	6	1	st1	1	2	1	d5	B	V	T	B	V	T
776	3.390	2	4	2	3	6	2	st3	2	3	4	d2	C	U	O	C	U	N
777	0.238	2	4	2	4	2	2	st3	2	4	4	d2	U	C	O	U	C	N
778	0.674	2	5	4	2	6	1	st3	2	1	4	d2	B	V	T	B	V	T
779	0.935	2	5	2	3	6	2	st3	2	4	4	d2	C	U	T	C	U	T
780	0.449	2	4	2	4	6	2	st3	2	4	4	d2	C	U	T	C	U	T
781	0.310	4	5	2	2	6	2	st2	2	4	2	d2	U	C	T	U	C	T
782	0.651	2	5	4	2	6	2	st3	2	1	4	d2	B	V	A	B	V	A
783	4.852	2	5	2	3	6	2	st3	2	2	4	d2	C	U	T	C	U	T
784	1.279	2	5	1	3	6	2	st3	2	2	2	d2	I	C	U	C	U	T
785	0.472	2	4	2	3	6	1	st3	2	4	4	d2	C	U	O	C	U	T
786	17.246	3	6	4	2	6	1	st1	1	1	1	d5	P	B	V	P	B	V
787	0.881	2	5	3	3	6	2	st3	2	4	4	d2	C	U	O	C	U	N
788	12.533	2	5	2	3	5	2	st3	2	2	2	d2	U	C	O	U	C	T
789	0.233	2	3	2	2	6	2	st5	2	4	4	d1	H	I	C	H	C	U
790	2.628	2	5	3	2	6	2	st3	2	4	4	d2	C	U	O	C	U	N
791	0.699	2	4	2	3	6	1	st3	2	4	4	d2	A	C	U	A	C	U
792	10.934	2	4	2	3	2	2	st3	2	4	4	d2	U	C	N	U	C	N
793	0.613	4	5	3	2	6	2	st2	2	2	2	d2	C	L	T	C	L	T
794	0.459	3	6	4	2	6	2	st1	1	1	1	d5	V	B	T	V	B	T
795	0.494	2	4	2	2	6	1	st3	2	4	4	d2	C	U	O	C	U	N
796	2.312	2	5	3	3	6	2	st3	2	2	4	d2	C	U	T	C	U	T

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
797	1.879	2	5	3	3	5	2	st3	2	2	2	d2	C	R	L	C	R	L
798	2.534	2	4	2	2	2	2	st5	2	3	1	d1	U	C	T	U	C	T
799	0.855	2	4	2	2	6	1	st3	2	4	4	d2	A	C	U	A	C	U
800	4.360	3	5	3	3	5	2	st3	2	3	4	d2	C	U	B	C	U	B
801	0.778	2	5	1	3	6	2	st3	2	2	4	d2	C	B	T	C	B	T
802	4.601	2	5	2	3	5	2	st3	2	3	2	d2	C	U	T	C	U	T
803	0.267	2	4	2	2	2	2	st3	2	4	4	d2	C	U	O	C	U	T
804	1.528	2	5	1	3	6	2	st3	2	2	2	d2	C	U	R	C	U	R
805	0.749	2	4	2	2	2	2	st5	2	1	1	d1	I	O	C	H	C	U
806	6.438	2	4	2	2	6	2	st3	2	4	4	d2	C	U	T	C	U	T
807	1.102	2	4	2	3	2	2	st5	2	4	2	d1	H	U	C	H	U	C
808	3.125	3	6	4	2	2	1	st1	1	1	1	d5	P	V	B	P	V	B
809	0.338	2	5	3	2	6	2	st3	2	1	4	d2	C	R	L	C	R	L
810	4.332	3	5	3	2	5	2	st3	2	3	4	d2	C	U	L	C	U	L
811	0.597	3	6	4	2	6	2	st1	1	1	1	d4	V	B	T	V	B	T
812	1.095	2	6	2	2	2	2	st2	2	1	2	d3	C	R	L	C	R	L
813	2.589	2	5	2	3	6	2	st3	2	2	2	d2	C	U	T	C	U	T
814	0.595	3	6	4	2	6	1	st1	1	4	1	d4	V	B	T	V	B	T
815	0.797	3	5	4	2	5	2	st3	2	2	4	d2	C	U	T	C	U	T
816	0.754	1	6	2	3	5	1	st2	2	2	2	d3	C	U	B	C	U	B
817	0.759	2	5	3	3	6	2	st3	2	4	4	d2	C	U	N	C	U	N
818	6.384	1	6	4	2	5	1	st2	2	2	2	d3	A	B	T	A	B	T
819	4.161	2	4	3	2	6	2	st3	2	3	4	d2	C	T	R	C	T	R
820	0.511	3	6	3	2	6	1	st1	1	1	1	d4	V	B	W	V	B	W
821	0.410	3	6	4	2	6	2	st1	1	1	1	d4	P	V	B	P	V	B
822	0.207	2	4	2	2	6	2	st3	2	1	4	d2	A	B	C	A	B	C
823	0.494	2	4	3	3	6	2	st3	2	3	4	d2	C	T	R	C	T	R
824	0.753	2	4	2	2	2	2	st3	2	4	4	d2	C	U	O	C	U	n
825	16.153	3	5	2	3	5	2	st3	2	3	4	d2	C	U	L	C	U	L
826	0.343	2	4	4	2	6	2	st3	2	1	4	d2	A	B	C	A	B	C
827	0.430	2	5	2	2	6	2	st3	2	3	4	d2	C	U	L	C	U	L
828	0.909	2	5	3	2	6	2	st3	2	3	4	d2	C	U	L	C	U	L
829	1.176	2	4	2	4	6	2	st3	2	4	4	d2	C	A	U	C	A	U
830	0.257	2	4	2	3	2	2	st5	2	4	1	d1	M	C	U	C	U	N
831	0.388	3	6	2	2	6	1	st1	1	4	1	d4	A	C	L	A	C	L
832	7.275	2	4	2	3	6	2	st3	2	3	4	d2	C	U	L	C	U	L
833	0.442	1	6	4	3	5	1	st2	2	2	2	d3	A	C	B	A	C	B
834	7.634	2	5	2	3	6	2	st3	2	3	2	d2	C	U	O	C	U	T
835	0.993	3	6	4	2	2	2	st1	1	1	1	d4	B	V	W	B	V	W
836	0.378	3	6	3	2	6	2	st1	1	1	1	d4	B	V	T	B	V	T

Table 35 (Contd...)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
837	0.572	3	6	3	2	6	2	st1	1	3	1	d4	B	A	W	B	A	W
838	0.560	2	5	2	2	6	2	st3	2	3	2	d2	C	U	O	C	U	T
839	2.840	3	6	4	2	2	1	st1	1	1	1	d4	P	V	B	P	V	B
840	2.390	3	5	3	2	5	2	st3	2	2	4	d2	B	A	C	B	A	C
841	0.451	2	4	2	2	6	2	st3	2	1	4	d2	A	B	C	A	B	C
842	0.552	2	4	2	2	6	1	st3	2	4	4	d2	C	L	R	C	L	R
843	4.557	2	4	2	2	2	2	st3	2	4	4	d2	U	C	O	U	C	N
844	1.400	2	4	2	2	6	2	st3	2	3	4	d2	C	U	L	C	U	L
845	2.022	2	5	3	2	6	2	st3	2	3	2	d2	C	U	O	C	U	T
846	1.037	2	4	2	3	6	2	st3	2	3	4	d2	C	U	L	C	U	L
847	0.214	3	6	2	2	2	1	st1	1	1	1	d4	P	V	B	P	V	B
848	0.456	2	3	2	2	2	1	st4	3	1	4	d1	I	W	C	W	C	T
849	0.754	2	5	2	3	5	2	st3	2	3	2	d2	C	U	O	C	U	T
850	1.087	5	4	2	3	2	1	st3	3	4	4	d1	A	C	U	A	C	U
851	1.097	2	5	4	2	6	1	st3	2	1	2	d2	V	W	B	V	W	B
852	9.271	2	3	2	2	2	2	st4	3	4	4	d1	H	U	C	H	U	C
853	3.185	2	3	2	2	2	2	st4	3	3	4	d1	H	U	C	H	U	C
854	0.453	2	5	4	2	6	2	st3	2	3	2	d2	A	C	U	A	C	U
855	0.815	2	4	1	3	2	2	st3	2	4	4	d2	U	C	H	U	C	H
856	3.435	2	4	2	3	3	2	st3	2	4	4	d2	C	U	O	C	U	N
857	0.468	2	3	2	3	2	2	st4	3	4	4	d1	H	U	C	H	U	C
858	4.891	5	3	2	3	2	2	st3	3	4	4	d1	H	U	C	H	U	C
859	7.443	2	5	2	3	5	2	st3	2	4	2	d2	C	U	N	C	U	N
860	3.371	2	4	2	3	6	2	st3	2	4	4	d2	C	U	O	C	U	N
861	3.401	2	3	2	3	2	2	st4	3	4	4	d1	U	C	O	U	C	N
862	7.471	2	5	3	2	6	2	st3	2	3	2	d2	C	U	O	C	U	T
863	0.591	1	6	4	2	5	2	st2	2	2	2	d3	W	V	B	W	V	B
864	6.364	5	3	2	3	2	2	st3	3	4	4	d1	U	C	H	U	C	H
865	0.214	2	5	2	2	6	2	st3	2	3	2	d2	C	U	O	C	U	T
866	0.749	1	6	2	2	5	1	st2	2	2	2	d3	C	R	L	C	R	L
867	0.763	2	3	2	2	2	2	st4	3	4	4	d1	H	U	C	H	U	C
868	0.414	2	5	4	2	6	2	st3	2	1	2	d2	W	B	T	W	B	T
869	7.948	2	5	2	3	6	2	st3	2	4	2	d2	C	U	N	C	U	N
870	0.257	2	4	2	2	2	2	st3	2	1	4	d2	C	U	T	C	U	T
871	1.288	3	5	3	3	5	2	st3	2	3	4	d2	C	U	L	C	U	L
872	0.778	2	5	3	2	6	2	st3	2	4	2	d2	C	U	H	C	U	H
873	0.500	2	5	3	3	6	2	st3	2	3	2	d2	C	U	O	C	U	T
874	0.386	2	5	2	2	5	1	st3	2	2	2	d2	C	B	T	C	B	T
875	0.595	2	4	2	2	6	2	st3	2	4	4	d2	U	C	H	U	C	H
876	2.478	2	5	2	2	5	2	st3	2	3	2	d2	C	U	T	C	U	T

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
877	0.378	3	6	4	2	6	1	st1	1	1	1	d4	P	V	B	P	V	B
878	2.801	2	3	2	3	2	2	st4	3	4	4	d1	H	U	C	H	U	C
879	1.030	2	5	2	2	5	2	st3	2	2	2	d2	C	B	T	C	B	T
880	0.353	2	4	4	2	2	2	st3	2	1	4	d2	C	L	T	C	L	T
881	1.605	2	4	2	3	2	2	st3	2	3	4	d2	C	U	N	C	U	N
882	1.590	2	5	2	2	5	2	st3	2	4	2	d2	C	U	O	C	U	N
883	0.345	2	5	3	2	6	2	st3	2	1	2	d2	A	C	T	A	C	T
884	0.329	2	4	2	2	6	2	st3	3	4	4	d2	A	C	N	A	C	N
885	0.352	3	6	2	2	6	1	st1	1	4	1	d4	A	C	L	A	C	L
886	1.354	3	5	2	3	6	2	st1	1	4	1	d2	C	U	M	C	U	R
887	3.510	3	5	2	2	6	2	st1	1	4	1	d2	C	U	M	C	U	R
888	1.366	2	4	2	2	6	1	st3	3	4	4	d2	A	C	N	A	C	N
889	2.851	2	4	2	3	6	2	st3	3	4	4	d2	A	C	N	A	C	N
890	4.320	2	4	2	3	6	2	st3	3	3	4	d2	C	U	H	C	U	H
891	3.184	2	5	2	2	6	2	st3	2	4	2	d2	U	C	H	U	C	H
892	5.595	2	4	2	2	3	2	st3	2	4	4	d2	U	H	C	U	H	C
893	0.309	3	5	4	2	5	2	st3	2	2	4	d2	C	L	U	C	L	U
894	0.753	5	3	2	2	2	2	st3	3	4	4	d1	H	U	C	H	U	C
895	0.847	2	4	2	2	6	2	st3	3	4	4	d2	A	C	N	A	C	N
896	0.280	5	3	2	2	2	2	st3	3	3	4	d1	H	C	U	H	C	U
897	0.453	5	3	2	3	2	2	st3	3	3	4	d1	H	C	U	H	C	U
898	0.469	5	3	2	3	3	2	st3	3	3	4	d1	H	C	U	H	C	U
899	3.782	5	3	2	3	3	2	st3	3	4	4	d1	H	C	U	H	C	U
900	1.093	3	5	2	2	5	2	st3	2	2	4	d2	C	U	N	C	U	N
901	4.548	3	5	2	2	5	2	st3	2	3	4	d2	C	U	N	C	U	N
902	0.953	2	3	2	2	2	1	st4	3	4	4	d1	H	U	C	H	U	C
903	1.970	2	5	2	2	6	2	st3	2	4	2	d2	U	C	O	U	C	N
904	0.781	2	4	2	2	6	2	st3	3	3	4	d2	C	U	H	C	U	H
905	6.856	5	5	2	3	5	2	st3	2	4	4	d2	U	C	O	U	C	N
906	26.342	2	5	2	2	6	2	st3	2	3	2	d2	C	U	O	C	U	T
907	0.496	2	4	4	2	3	2	st3	2	4	4	d2	U	C	N	U	C	N
908	4.192	3	6	4	2	3	1	st2	1	2	1	d3	V	B	T	V	B	T
909	2.843	3	5	2	3	3	2	st1	1	4	3	d3	C	U	N	C	U	N
910	0.523	3	6	4	3	3	1	st2	1	2	1	d3	V	B	T	V	B	T
911	4.635	2	6	2	2	2	2	st3	2	4	4	d2	U	C	H	U	C	H
912	1.376	3	5	2	2	3	2	st1	1	4	3	d3	C	U	N	C	U	N
913	0.378	3	6	4	2	3	2	st2	1	4	1	d3	C	U	O	C	U	R
914	3.290	5	3	2	2	3	2	st3	3	4	4	d1	H	M	U	H	U	C
915	1.350	5	3	1	3	3	2	st3	3	4	4	d1	H	M	U	H	U	C
916	5.467	2	3	2	3	2	2	st4	3	4	4	d1	H	M	U	H	U	C

Table 35 (Contd...)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
917	7.370	5	3	2	3	3	2	st3	3	4	4	d1	H	M	U	H	U	C
918	0.286	2	5	2	2	5	1	st3	2	4	2	d2	U	C	R	U	C	R
919	4.141	2	5	2	2	6	2	st3	2	2	2	d2	C	U	T	C	U	T
920	0.300	2	5	4	2	6	2	st3	2	1	2	d2	C	U	T	C	U	T
921	0.336	2	5	2	2	6	2	st3	2	3	2	d2	A	C	O	A	C	U
922	0.205	2	5	2	2	6	2	st3	2	1	2	d2	C	L	T	C	L	T
923	0.314	3	6	2	2	6	1	st1	1	4	1	d4	U	C	N	U	C	N
924	0.247	2	5	2	3	6	2	st3	2	3	2	d2	C	U	O	C	U	T
925	8.372	2	6	2	3	2	2	st3	2	4	4	d2	U	C	H	U	C	H
926	0.564	3	6	2	2	6	1	st1	1	2	1	d4	B	A	C	B	A	C
927	0.718	2	5	2	3	6	2	st3	2	4	2	d2	U	C	O	U	C	N
928	0.590	3	6	4	2	6	2	st1	1	2	1	d4	V	B	A	V	B	A
929	3.279	2	4	2	2	6	2	st3	3	4	4	d2	C	U	H	C	U	H
930	8.721	3	6	4	2	6	1	st1	1	2	1	d4	V	B	T	V	B	T
931	0.488	3	6	2	2	6	2	st1	1	3	1	d4	B	A	C	B	A	C
932	0.384	3	5	4	2	5	1	st3	2	2	4	d2	A	C	L	A	C	L
933	0.342	2	5	2	3	6	2	st3	2	4	2	d2	U	C	O	U	C	N
934	1.244	2	5	2	2	6	2	st3	2	4	2	d2	U	C	O	U	C	N
935	0.485	3	6	2	2	3	2	st2	1	2	1	d3	A	C	U	A	C	U
936	1.268	2	6	2	2	2	2	st3	2	5	4	d2	U	H	C	U	H	C
937	4.264	2	4	2	2	6	2	st3	2	4	4	d2	U	C	H	U	C	H
938	32.992	2	6	2	2	2	2	st3	2	4	4	d2	U	C	H	U	C	H
939	1.034	2	3	2	4	2	3	st4	3	5	4	d1	H	U	C	H	U	C
940	2.751	2	3	2	3	2	3	st4	3	4	4	d1	H	C	U	H	C	U
941	0.284	2	3	2	4	2	3	st4	3	4	4	d1	H	C	U	H	C	U
942	3.564	2	3	2	3	3	2	st4	3	4	4	d1	H	C	U	H	C	U
943	1.759	3	5	2	3	3	2	st1	1	4	3	d3	C	U	H	C	U	H
944	0.576	2	6	2	1	2	2	st3	2	4	4	d2	U	C	H	U	C	H
945	0.610	5	5	2	2	5	2	st3	2	4	4	d2	C	U	O	C	U	N
946	0.541	3	5	2	2	5	1	st3	2	2	4	d2	A	C	T	A	C	T
947	0.396	3	6	4	2	6	1	st1	1	1	1	d4	V	B	T	V	B	T
948	1.086	2	5	1	3	6	2	st3	2	4	2	d2	U	C	H	U	C	H
949	0.273	2	5	4	2	6	2	st3	2	3	2	d2	C	L	T	C	L	T
950	5.468	2	5	2	3	5	2	st3	2	3	4	d2	C	U	T	C	U	T
951	0.658	3	5	2	2	5	2	st3	2	3	4	d2	C	U	T	C	U	T
952	1.099	2	6	2	3	2	2	st3	2	5	4	d2	U	H	C	U	H	C
953	0.626	2	3	2	4	3	3	st4	3	4	4	d1	H	C	U	H	C	U
954	1.611	5	5	2	3	6	2	st3	2	4	4	d2	C	U	O	C	U	N
955	3.605	3	5	2	2	5	2	st3	2	4	4	d2	C	U	O	C	U	N
956	0.846	3	6	4	2	6	1	st1	1	4	1	d4	A	C	B	A	C	B
957	1.431	5	3	2	2	3	2	st3	3	4	4	d1	H	C	U	H	C	U

Table 35 (Contd...)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
958	0.336	3	6	2	2	6	1	st1	1	4	1	d4	V	B	A	V	B	A
959	0.381	2	3	1	4	2	3	st4	3	5	4	d1	H	U	C	H	U	C
960	1.075	2	5	2	2	5	2	st3	2	3	4	d2	C	U	O	C	U	T
961	1.494	2	5	2	3	6	2	st3	2	3	2	d2	C	U	O	C	U	T
962	0.665	2	3	2	4	3	3	st4	3	5	4	d1	H	U	C	H	U	C
963	4.787	2	6	2	3	2	3	st3	2	5	4	d2	U	H	C	U	H	C
964	9.489	5	5	2	2	6	2	st3	2	4	4	d2	U	C	O	U	C	N
965	2.954	3	5	2	2	3	2	st1	1	4	3	d3	C	U	N	C	U	N
966	19.064	5	6	4	2	5	1	st2	1	2	2	d4	V	W	B	V	W	B
967	0.302	2	6	2	3	2	3	st3	2	4	4	d2	U	C	H	U	C	H
968	1.550	2	3	2	4	2	3	st4	3	4	4	d1	H	U	C	H	U	C
969	0.424	2	6	2	4	2	3	st3	2	5	4	d2	U	H	C	U	H	C
970	1.801	2	5	3	2	5	2	st3	2	3	4	d2	C	U	O	C	U	T
971	0.382	2	5	2	3	5	2	st3	2	3	4	d2	C	U	O	C	U	T
972	1.264	2	6	2	4	2	3	st3	2	4	4	d2	U	C	H	U	C	H
973	0.534	5	6	4	2	5	1	st2	1	4	2	d4	C	U	T	C	U	T
974	2.207	2	6	2	4	2	2	st3	2	4	4	d2	C	U	H	C	U	H
975	0.377	3	6	4	2	6	1	st1	1	3	1	d4	V	B	T	V	B	T
976	0.598	2	6	1	3	2	3	st3	2	5	4	d2	U	H	C	U	H	C
977	0.916	2	6	2	4	2	3	st3	2	5	4	d2	U	H	C	U	H	C
978	2.765	2	4	2	2	6	2	st3	3	3	4	d2	C	U	N	C	U	N
979	0.207	2	6	1	4	2	3	st3	2	5	4	d2	U	H	C	U	H	C
980	0.475	3	5	2	2	6	1	st2	1	4	3	d2	A	C	T	A	C	T
981	0.353	2	4	2	2	6	2	st3	3	1	4	d2	C	W	L	C	W	L
982	1.862	2	6	2	2	2	3	st3	2	5	4	d2	U	H	C	U	H	C
983	0.242	2	3	2	4	3	2	st4	3	4	4	d1	H	C	U	H	C	U
984	0.278	2	5	3	3	5	2	st3	2	3	4	d2	C	U	O	C	U	T
985	2.548	3	5	2	2	6	2	st2	1	4	3	d2	A	C	T	A	C	T
986	5.203	3	6	4	2	6	1	st1	1	1	1	d4	P	V	B	P	V	B
987	0.305	5	5	2	2	6	2	st3	2	2	4	d2	C	L	T	C	L	T
988	0.673	2	4	2	3	6	2	st3	2	4	4	d2	U	C	H	U	C	H
989	1.216	3	6	4	2	6	2	st1	1	2	1	d4	B	V	A	B	V	A
990	0.260	2	3	1	4	2	3	st4	3	4	4	d1	H	C	U	H	C	U
991	3.581	2	5	3	2	5	2	st3	2	4	4	d2	C	U	O	C	U	H
992	0.541	3	5	4	2	3	1	st2	1	2	3	d2	B	A	T	B	A	T
993	0.666	2	3	2	4	3	2	st3	3	5	4	d1	H	U	C	H	U	C
994	2.423	2	6	2	1	2	2	st3	2	3	4	d2	C	U	L	C	U	L
995	3.672	2	6	2	2	2	2	st3	2	3	4	d2	C	U	L	C	U	L
996	2.918	2	6	2	4	2	3	st3	2	4	4	d2	U	C	H	U	C	H
997	0.553	3	6	2	2	6	1	st1	1	3	1	d4	V	B	T	V	B	T

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
998	1.735	2	5	2	2	5	2	st3	2	4	4	d2	U	C	O	U	C	N
999	0.482	2	5	1	3	6	2	st3	2	3	2	d2	C	U	T	C	U	T
1000	2.397	3	5	2	2	3	2	st2	1	4	3	d2	C	U	T	C	U	T
1001	0.361	2	5	1	2	6	2	st3	2	3	2	d2	C	U	N	C	U	N
1002	0.590	3	5	2	2	3	1	st1	1	4	3	d3	C	L	T	C	L	T
1003	0.503	3	5	2	2	6	2	st2	1	4	3	d2	C	U	N	C	U	N
1004	0.422	3	5	2	2	3	2	st1	1	4	3	d3	C	U	N	C	U	N
1005	0.544	3	6	2	2	6	1	st1	1	1	1	d4	V	G	B	V	G	B
1006	0.528	2	3	2	3	2	2	st4	3	4	4	d1	H	C	U	H	C	U
1007	2.091	5	4	2	3	5	2	st4	3	4	4	d2	U	C	H	U	C	H
1008	0.477	2	4	2	2	6	2	st3	2	3	4	d2	C	U	O	C	U	T
1009	0.710	2	3	2	3	2	3	st4	3	5	4	d1	H	U	C	H	U	C
1010	1.904	3	5	2	2	6	2	st2	1	3	3	d2	C	L	U	C	L	U
1011	0.381	2	3	2	3	3	2	st3	3	4	4	d1	H	U	C	H	U	C
1012	1.146	3	5	2	3	3	2	st2	1	4	3	d2	C	U	O	C	U	N
1013	0.201	3	5	2	2	6	1	st2	1	4	3	d2	C	L	R	C	L	R
1014	0.302	3	5	2	2	6	1	st2	1	3	3	d2	C	R	T	C	R	T
1015	0.317	2	3	2	3	2	2	st4	3	5	4	d1	H	U	C	H	U	C
1016	1.927	2	6	2	3	2	3	st3	2	4	4	d2	C	U	H	C	U	H
1017	5.048	2	6	2	3	2	2	st3	2	4	4	d2	U	H	C	U	H	C
1018	1.484	3	5	2	3	6	2	st2	1	4	3	d2	C	U	O	C	U	H
1019	0.268	2	6	2	2	2	2	st3	2	5	4	d2	U	H	C	U	H	C
1020	0.402	3	5	4	2	6	2	st2	1	3	3	d2	C	L	U	C	L	U
1021	5.662	2	3	2	3	3	2	st3	3	4	4	d1	H	U	C	H	U	C
1022	1.759	5	4	2	3	5	2	st4	3	3	4	d2	C	O	U	C	U	N
1023	2.502	5	4	2	3	6	2	st4	3	3	4	d2	C	O	U	C	U	H
1024	1.947	3	5	4	2	6	1	st2	1	3	3	d2	C	L	T	C	L	T
1025	0.225	2	3	2	3	3	2	st3	3	5	4	d1	H	U	C	H	U	C
1026	0.545	2	3	2	3	2	2	st3	3	5	4	d1	H	U	C	H	U	C
1027	0.353	2	5	2	2	5	2	st3	2	4	4	d2	C	U	O	C	U	N
1028	0.263	5	6	4	2	5	2	st2	1	2	2	d4	B	A	C	B	A	C
1029	1.034	2	3	2	2	3	2	st3	3	4	4	d1	H	U	C	H	U	C
1030	1.211	2	6	2	2	3	2	st3	2	4	4	d2	C	U	N	C	U	N
1031	0.466	3	5	2	2	6	2	st2	1	4	3	d2	C	U	O	C	U	L
1032	0.562	5	4	2	3	6	2	st4	3	4	4	d2	H	U	C	H	U	C
1033	8.066	2	5	3	2	5	2	st3	2	2	4	d2	C	B	U	C	B	U
1034	0.260	5	5	4	2	6	2	st3	2	2	4	d2	B	A	C	B	A	C
1035	1.517	2	3	2	3	2	2	st3	3	4	4	d1	H	U	C	H	U	C
1036	0.231	2	3	2	2	2	2	st3	3	4	4	d1	H	C	U	H	C	U
1037	0.516	3	5	2	2	3	2	st1	1	3	3	d3	C	L	B	C	L	B
1038	0.800	2	6	2	3	3	2	st3	2	4	4	d2	C	U	N	C	U	N
1039	1.354	5	4	2	3	4	2	st4	3	3	4	d2	C	O	U	C	U	H
1040	0.395	2	5	2	2	5	1	st3	2	2	4	d2	B	C	L	B	C	L
1041	0.838	2	6	2	3	2	3	st3	2	5	4	d2	U	C	H	U	C	H

Table 35 (Contd...)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
1042	2.634	5	4	2	2	4	2	st4	3	3	4	d2	C	O	U	C	U	H
1043	1.201	3	5	4	2	3	1	st1	1	2	3	d3	V	G	B	V	G	B
1044	0.997	2	6	2	1	2	2	st3	2	4	4	d2	U	C	H	U	C	H
1045	0.268	2	5	2	3	5	2	st3	2	4	4	d2	C	U	O	C	U	H
1046	8.154	5	5	2	2	5	2	st3	2	3	4	d2	C	O	U	C	U	N
1047	2.086	2	6	2	3	6	2	st3	2	4	4	d2	C	U	N	C	U	N
1048	11.608	2	4	2	2	3	2	st2	2	4	4	d1	C	U	O	C	U	H
1049	0.759	3	5	4	2	3	1	st1	1	3	3	d3	V	G	B	V	G	B
1050	0.719	2	5	4	2	5	2	st3	2	2	4	d2	B	A	C	B	A	C
1051	0.305	3	5	4	2	3	2	st1	1	3	3	d3	V	G	B	V	G	B
1052	1.876	2	4	2	2	3	2	st2	2	3	4	d1	B	A	C	B	A	C
1053	1.844	2	6	1	3	3	2	st3	2	4	4	d2	U	C	H	U	C	H
1054	1.351	2	6	1	3	6	2	st3	2	4	4	d2	U	C	H	U	C	H
1055	0.576	5	5	2	3	6	2	st3	2	4	4	d2	U	C	O	U	C	N
1056	0.866	2	5	2	2	5	2	st3	2	4	4	d2	C	U	O	C	U	N
1057	4.089	2	5	2	3	5	2	st3	2	4	4	d2	C	U	O	C	U	H
1058	7.947	2	5	2	2	6	2	st3	2	4	2	d2	C	U	O	C	U	L
1059	0.781	2	5	2	3	6	2	st3	2	3	2	d2	C	U	O	C	U	L
1060	0.324	2	6	2	3	2	2	st3	2	4	4	d2	U	C	H	U	C	H
1061	1.394	2	6	2	3	2	2	st3	2	5	4	d2	U	C	H	U	C	H
1062	2.058	2	4	2	3	3	2	st3	2	4	4	d1	C	U	N	C	U	N
1063	1.453	2	4	2	2	6	2	st2	2	4	4	d1	C	U	N	C	U	N
1064	9.271	2	4	2	2	3	2	st3	2	4	4	d1	C	U	H	C	U	H
1065	1.746	2	4	2	3	6	2	st2	2	4	4	d1	C	U	N	C	U	N
1066	2.237	2	5	2	3	6	2	st3	2	4	2	d2	C	U	O	C	U	L
1067	3.277	2	4	2	2	6	2	st2	2	3	4	d1	C	U	T	C	U	T
1068	0.446	2	4	4	2	3	2	st2	2	3	4	d1	B	A	C	B	A	C
1069	0.480	2	4	2	2	3	1	st3	2	2	4	d1	C	L	T	C	L	T
1070	0.692	2	6	2	2	2	2	st3	2	5	4	d2	U	C	H	U	C	H
1071	0.439	2	3	2	3	3	2	st3	3	5	4	d1	H	U	C	H	U	C
1072	0.281	5	4	2	2	6	2	st4	3	3	4	d2	C	O	U	C	U	H
1073	1.608	2	4	2	3	3	2	st3	2	4	4	d1	C	U	H	C	U	H
1074	11.547	5	5	2	2	6	2	st3	2	3	4	d2	C	U	N	C	U	N
1075	1.210	5	4	2	3	4	2	st4	3	3	4	d2	C	U	H	C	U	H
1076	0.692	2	3	2	4	3	2	st3	3	4	4	d1	H	C	U	H	C	U
1077	0.906	2	3	2	4	3	2	st3	3	5	4	d1	H	U	C	H	U	C
1078	20.830	5	5	2	2	4	2	st3	2	3	4	d2	C	O	U	C	U	T
1079	1.848	2	5	2	3	6	2	st3	2	3	2	d2	C	U	L	C	U	L
1080	0.330	3	5	4	2	3	1	st1	1	2	3	d3	V	B	A	V	B	A
1081	0.254	2	6	2	2	2	2	st3	2	4	4	d2	C	U	H	C	U	H

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
1082	2.190	3	5	2	3	2	2	st2	2	4	4	d2	U	C	H	U	C	H
1083	0.246	2	4	2	3	3	2	st2	2	4	4	d1	C	U	O	C	U	T
1084	0.283	2	5	2	3	5	2	st3	2	4	4	d2	C	U	O	C	U	T
1085	1.526	2	6	2	2	2	2	st3	2	3	4	d2	C	U	N	C	U	N
1086	0.482	5	4	1	3	5	2	st4	3	4	4	d2	H	C	U	H	C	U
1087	0.454	3	5	2	2	6	2	st2	1	3	3	d2	C	L	T	C	L	T
1088	8.422	3	6	4	2	4	1	st1	1	2	1	d4	P	V	B	P	V	B
1089	1.693	3	6	4	2	4	2	st1	1	2	1	d4	V	B	T	V	B	T
1090	0.814	3	5	1	4	2	2	st2	2	4	4	d4	U	H	C	U	H	C
1091	0.397	5	5	2	2	4	1	st3	2	2	4	d2	B	A	T	B	A	T
1092	0.489	3	6	2	2	6	1	st1	1	1	1	d4	V	G	B	V	G	B
1093	0.520	5	5	2	2	4	2	st3	2	2	4	d2	B	A	T	B	A	T
1094	0.442	5	5	2	3	5	2	st3	2	3	4	d2	C	O	U	C	U	T
1095	0.738	2	5	1	3	6	2	st3	2	4	2	d2	C	U	H	C	U	H
1096	0.429	2	6	1	2	3	2	st3	2	4	4	d2	U	C	O	U	C	N
1097	0.360	2	6	2	3	2	2	st3	2	5	4	d2	U	C	H	U	C	H
1098	0.808	2	6	2	3	2	2	st3	2	4	4	d2	C	U	O	C	U	N
1099	0.506	2	6	2	2	3	2	st3	2	4	4	d2	C	U	O	C	U	N
1100	0.397	3	5	2	2	3	1	st1	1	2	3	d3	A	C	L	A	C	L
1101	1.743	2	4	2	3	3	2	st3	2	4	4	d1	C	U	O	C	U	N
1102	0.943	2	6	2	3	2	3	st3	2	5	4	d2	U	C	H	U	C	H
1103	0.701	2	3	2	3	2	2	st3	3	5	4	d1	H	U	C	H	U	C
1104	0.694	2	5	2	2	6	1	st3	2	2	2	d2	B	A	C	B	A	C
1105	4.660	2	5	2	3	5	2	st3	2	3	4	d2	C	U	N	C	U	N
1106	0.423	5	4	2	3	5	2	st4	3	3	4	d2	H	C	U	H	C	U
1107	8.492	2	6	2	3	2	3	st3	2	4	4	d2	C	U	O	C	U	H
1108	2.197	3	5	2	3	2	2	st2	2	5	4	d3	U	H	C	U	H	C
1109	0.239	3	6	2	2	6	2	st1	1	4	1	d3	C	U	L	C	U	L
1110	0.893	2	3	2	3	2	2	st3	3	4	4	d1	H	U	C	H	U	C
1111	0.347	3	6	4	2	6	2	st1	1	2	1	d4	V	B	T	V	B	T
1112	0.274	5	6	2	2	5	1	st2	1	2	2	d4	A	L	C	A	L	C
1113	0.623	3	6	2	2	6	1	st1	1	4	1	d3	A	C	O	A	C	B
1114	0.236	2	4	2	3	6	2	st2	2	3	4	d1	C	O	U	C	U	L
1115	0.206	3	5	2	4	2	2	st2	2	5	4	d4	U	H	C	U	H	C
1116	1.121	2	4	2	2	6	2	st2	2	4	4	d1	C	U	L	C	U	L
1117	0.492	3	6	2	2	6	1	st1	1	2	1	d4	V	B	T	V	B	T
1118	0.347	2	6	2	4	2	3	st3	2	5	4	d2	U	C	H	U	C	H
1119	0.515	5	5	2	2	5	1	st3	2	2	4	d2	A	L	C	A	L	C
1120	13.032	3	5	2	2	2	2	st2	2	4	4	d4	C	H	U	C	H	U
1121	0.585	2	4	1	3	3	2	st3	2	4	4	d1	C	U	O	C	U	H

Table 35 (Contd...)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
1122	0.217	5	5	2	2	5	2	st3	2	2	4	d2	A	L	C	A	L	C
1123	0.759	2	6	2	4	2	3	st3	2	4	4	d2	C	U	H	C	U	H
1124	1.047	5	4	2	2	5	2	st4	3	3	4	d2	C	O	U	C	U	H
1125	0.341	3	5	2	3	2	2	st2	2	4	4	d3	U	C	H	U	C	H
1126	0.246	3	5	2	2	2	2	st2	2	5	4	d2	U	C	H	U	C	H
1127	0.474	2	6	1	2	3	2	st3	2	4	4	d2	U	C	H	U	C	H
1128	0.711	2	5	2	2	5	2	st3	2	4	4	d2	C	O	U	C	U	N
1129	2.864	2	6	2	1	2	2	st3	2	4	4	d2	C	U	T	C	U	T
1130	0.410	2	3	2	2	2	2	st3	3	4	4	d1	H	U	C	H	U	C
1131	0.616	2	6	2	2	2	3	st3	2	4	4	d2	C	U	O	C	U	H
1132	3.986	3	6	2	2	3	2	st2	1	4	1	d3	C	U	T	C	U	T
1133	0.239	2	6	1	3	3	2	st3	2	4	4	d2	U	C	H	U	C	H
1134	3.370	3	6	2	2	3	1	st1	1	2	1	d3	V	B	T	V	B	T
1135	4.186	5	4	2	2	4	2	st3	2	3	4	d2	C	O	U	C	U	T
1136	0.791	3	6	2	2	4	1	st1	1	2	1	d4	V	B	T	V	B	T
1137	0.282	3	6	4	2	6	2	st1	1	4	1	d4	A	C	B	A	C	B
1138	1.289	2	4	2	3	3	2	st2	2	4	4	d1	U	C	O	U	C	N
1139	0.419	2	5	2	3	5	2	st3	2	4	4	d2	C	U	N	C	U	N
1140	0.333	2	6	1	4	2	3	st3	2	4	4	d2	U	C	H	U	C	H
1141	0.425	2	6	1	3	2	3	st3	2	4	4	d2	U	C	H	U	C	H
1142	0.906	3	6	2	2	3	2	st2	1	4	1	d3	C	U	T	C	U	T
1143	2.183	2	4	2	2	6	2	st3	2	4	4	d2	C	H	U	C	H	U
1144	0.609	3	6	2	2	6	1	st1	1	2	1	d4	V	B	T	V	B	T
1145	6.596	2	4	2	2	3	2	st3	2	4	4	d2	C	U	O	C	U	N
1146	0.321	5	5	2	2	5	1	st3	2	3	4	d2	A	L	C	A	L	C
1147	0.381	2	5	2	2	6	1	st3	2	4	2	d2	A	C	L	A	C	L
1148	11.168	2	5	2	2	2	2	st3	2	4	4	d2	U	C	H	U	C	H
1149	0.597	3	6	2	2	4	1	st1	1	2	1	d4	V	B	T	V	B	T
1150	0.512	2	6	2	3	2	2	st3	2	4	4	d2	C	U	O	C	U	N
1151	0.938	5	4	2	2	4	2	st3	2	2	4	d2	B	A	C	B	A	C
1152	5.333	3	6	4	2	2	1	st1	1	2	1	d4	P	V	B	P	V	B
1153	0.271	3	5	4	2	2	1	st2	2	4	4	d4	V	B	T	V	B	T
1154	0.298	5	4	4	2	4	2	st3	2	2	4	d2	B	A	C	B	A	C
1155	0.554	3	6	2	2	3	1	st2	1	4	1	d3	B	A	C	B	A	C
1156	0.406	3	6	2	2	3	2	st2	1	1	1	d3	V	B	A	V	B	A
1157	0.471	5	4	2	2	4	1	st3	2	2	4	d2	B	A	C	B	A	C
1158	0.808	2	5	2	3	3	2	st3	2	4	4	d2	C	U	H	C	U	H
1159	7.393	2	5	2	3	2	2	st3	2	4	4	d2	C	U	O	C	U	H
1160	0.693	2	4	2	3	6	2	st3	2	4	4	d2	C	U	H	C	U	H
1161	0.341	3	6	4	2	3	2	st2	1	1	1	d3	V	B	A	V	B	A

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
1162	0.205	3	6	4	2	3	1	st2	1	4	1	d3	C	U	T	C	U	T
1163	0.786	5	5	2	2	5	1	st3	2	2	4	d2	B	A	C	B	A	C
1164	11.556	2	4	2	2	3	2	st3	2	4	4	d1	C	U	O	C	U	H
1165	0.255	2	4	2	2	3	1	st3	2	4	4	d1	B	A	C	B	A	C
1166	1.507	2	4	2	2	3	2	st3	2	3	4	d1	C	U	H	C	U	H
1167	1.465	2	6	2	2	2	3	st3	2	4	4	d2	C	U	O	C	U	H
1168	0.467	3	6	4	2	3	1	st2	1	1	1	d3	V	B	T	V	B	T
1169	0.754	5	6	4	2	5	2	st2	1	2	2	d4	V	B	T	V	B	T
1170	0.578	3	6	4	2	6	2	st1	1	2	1	d4	V	B	T	V	B	T
1171	0.679	3	6	4	2	3	2	st1	1	1	1	d4	V	B	T	V	B	T
1172	0.999	2	5	2	2	5	2	st3	2	3	4	d2	C	U	N	C	U	N
1173	0.539	4	4	2	2	5	2	st3	3	2	4	d2	C	O	U	C	U	T
1174	0.923	3	6	4	2	3	1	st1	1	1	1	d4	P	V	B	P	V	B
1175	2.741	4	4	3	2	5	2	st3	3	3	4	d2	H	C	U	H	C	U
1176	13.532	4	4	2	2	5	2	st3	3	3	4	d2	H	C	U	H	C	U
1177	0.256	2	4	2	3	3	2	st3	2	3	4	d1	C	U	H	C	U	H
1178	0.234	3	6	2	2	3	1	st2	1	1	1	d3	V	B	A	V	B	A
1179	4.159	2	4	2	3	3	2	st3	2	4	4	d1	C	U	O	C	U	N
1180	1.443	2	4	1	3	6	2	st3	2	4	4	d2	H	U	C	H	U	C
1181	0.576	2	4	1	3	3	2	st3	2	4	4	d2	H	U	C	H	U	C
1182	0.364	5	6	3	2	5	1	st2	1	2	2	d4	V	B	T	V	B	T
1183	0.315	2	5	2	3	3	2	st3	2	3	4	d2	C	U	H	C	U	H
1184	0.313	5	5	2	2	5	2	st3	2	2	4	d2	B	A	C	B	A	C
1185	0.887	2	4	2	3	3	2	st3	2	4	4	d1	U	C	H	U	C	H
1186	0.223	5	5	2	2	6	2	st3	2	2	4	d2	C	R	L	C	R	L
1187	0.357	3	6	2	2	3	2	st1	1	4	1	d4	B	A	C	B	A	C
1188	1.228	2	5	3	2	5	2	st3	2	3	4	d2	C	U	H	C	U	H
1189	1.255	3	6	2	2	3	1	st1	1	4	1	d4	V	B	T	V	B	T
1190	0.750	3	6	2	2	3	1	st1	1	1	1	d4	V	B	T	V	B	T
1191	0.827	5	5	2	2	4	2	st3	2	2	4	d2	B	A	C	B	A	C
1192	0.414	3	6	2	2	3	2	st2	1	4	1	d3	B	A	C	B	A	C
1193	0.623	5	5	4	2	6	2	st3	2	2	4	d2	C	R	L	C	R	L
1194	1.515	2	4	2	2	1	2	st3	2	3	4	d1	C	U	H	C	U	H
1195	4.704	2	6	2	2	2	2	st3	2	5	4	d2	U	H	C	U	H	C
1196	3.200	7	5	3	2	5	2	st3	2	4	4	d2	C	H	U	C	H	U
1197	1.575	2	4	2	2	1	2	st3	2	4	4	d1	C	U	H	C	U	H
1198	0.915	4	4	3	2	5	2	st3	3	4	4	d2	H	C	O	H	C	U
1199	0.915	3	5	2	2	6	1	st1	1	4	1	d3	B	A	C	B	A	C
1200	6.429	2	5	2	3	1	2	st3	2	4	4	d2	C	U	N	C	U	N
1201	0.286	2	4	2	2	3	1	st3	2	4	4	d1	U	C	H	U	C	H

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
1202	2.660	3	5	2	2	6	2	st1	1	4	1	d3	B	A	C	B	A	C
1203	9.842	7	5	2	3	5	2	st3	2	3	4	d2	C	H	U	C	H	U
1204	0.751	3	6	4	2	4	2	st1	1	2	1	d4	B	V	T	B	V	T
1205	12.334	4	4	2	2	4	2	st3	3	3	4	d2	C	H	U	C	H	U
1206	1.610	3	6	4	2	3	1	st1	1	1	1	d4	P	V	B	P	V	B
1207	0.395	5	5	2	3	6	2	st3	2	3	4	d2	C	U	N	C	U	N
1208	0.792	2	4	4	2	3	2	st3	2	1	4	d2	B	G	T	B	G	T
1209	1.518	7	5	3	3	5	2	st3	2	4	4	d2	C	H	U	C	H	U
1210	0.247	3	5	2	2	2	2	st2	2	5	4	d2	U	H	C	U	H	C
1211	16.867	2	5	2	2	1	2	st3	2	4	4	d2	C	U	H	C	U	H
1212	0.208	2	4	2	3	6	2	st3	2	4	4	d2	C	U	O	C	U	N
1213	2.208	7	5	3	2	5	2	st3	2	3	4	d2	C	H	U	C	H	U
1214	0.502	5	5	1	2	6	2	st3	2	3	4	d2	U	C	H	U	C	H
1215	0.751	7	5	3	2	5	1	st3	2	2	4	d2	C	O	B	C	B	T
1216	0.827	7	4	2	3	5	2	st3	2	4	4	d2	C	H	U	C	H	U
1217	0.336	2	4	1	2	3	2	st3	2	4	4	d2	C	H	U	C	H	U
1218	0.328	7	5	2	3	5	2	st3	2	4	4	d2	C	H	U	C	H	U
1219	1.342	7	5	3	2	5	2	st3	2	2	4	d2	C	O	U	C	H	U
1220	2.087	2	4	2	2	6	2	st3	2	4	4	d2	C	U	O	C	U	N
1221	0.597	2	4	2	3	3	2	st3	2	4	4	d1	C	U	O	C	U	N
1222	1.019	2	4	1	3	3	2	st3	2	4	4	d1	H	U	C	H	U	C
1223	0.961	5	5	2	2	4	1	st3	2	3	4	d2	C	U	N	C	U	N
1224	0.347	7	4	2	2	5	2	st3	2	4	4	d2	C	H	U	C	H	U
1225	0.354	3	6	4	2	4	1	st1	1	3	1	d4	V	B	T	V	B	T
1226	0.768	2	6	1	2	2	2	st3	2	5	4	d2	U	H	C	U	H	C
1227	0.510	3	5	2	1	2	2	st2	2	4	4	d3	U	C	N	U	C	N
1228	6.498	3	6	4	2	4	1	st1	1	1	1	d4	P	V	B	P	V	B
1229	2.132	4	4	2	2	4	2	st3	3	2	4	d2	C	O	B	C	B	W
1230	0.207	7	4	3	2	5	2	st3	2	3	4	d2	C	H	B	C	H	B
1231	0.935	2	4	1	3	3	2	st3	2	4	4	d1	U	H	C	U	H	C
1232	1.605	4	4	2	3	5	2	st3	3	3	4	d2	C	H	U	C	H	U
1233	1.557	7	5	4	2	5	1	st3	2	2	4	d2	W	B	T	W	B	T
1234	4.459	2	5	2	2	1	2	st3	2	3	4	d2	C	U	N	C	U	N
1235	0.432	3	6	2	2	4	1	st1	1	3	1	d4	B	C	T	B	C	T
1236	0.276	2	4	2	3	1	2	st3	2	4	4	d1	U	C	H	U	C	H
1237	0.449	7	5	4	2	5	2	st3	2	2	4	d2	C	O	B	C	B	T
1238	5.019	3	6	4	1	2	1	st1	1	2	1	d4	P	V	B	P	V	B
1239	0.226	7	4	3	3	5	2	st3	2	3	4	d2	C	O	B	C	B	T
1240	0.327	2	4	2	2	1	2	st3	2	4	4	d1	U	C	H	U	C	H
1241	1.155	3	6	4	2	6	1	st1	1	2	1	d4	V	B	T	V	B	T

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
1242	0.713	3	6	4	2	4	2	st1	1	1	1	d4	V	B	T	V	B	T
1243	0.380	2	4	2	3	1	2	st3	2	4	4	d1	U	C	H	U	C	H
1244	0.492	2	4	1	2	3	2	st3	2	4	4	d1	U	H	C	U	H	C
1245	9.596	7	4	2	3	5	2	st3	2	3	4	d2	C	U	B	C	U	B
1246	2.837	3	6	2	2	2	2	st1	1	4	1	d4	V	B	T	V	B	T
1247	0.234	2	4	4	2	4	2	st3	2	1	4	d2	B	T	A	B	T	A
1248	0.748	2	4	2	2	3	2	st3	2	1	4	d2	C	B	T	C	B	T
1249	2.122	2	4	2	2	6	2	st3	2	3	4	d2	C	U	H	C	U	H
1250	6.815	2	4	3	2	4	2	st3	2	1	4	d2	C	L	U	C	L	U
1251	7.555	2	4	3	2	4	2	st3	2	4	4	d2	U	C	N	U	C	N
1252	0.389	3	6	3	2	4	1	st1	1	2	1	d4	B	C	T	B	C	T
1253	1.282	2	4	2	2	3	2	st3	2	3	4	d2	C	U	H	C	U	H
1254	0.298	2	5	2	2	2	1	st3	2	2	4	d2	C	U	T	C	U	T
1255	9.928	2	5	2	2	2	2	st3	2	4	4	d2	U	C	N	U	C	N
1256	0.354	2	4	2	2	1	2	st3	2	4	4	d1	U	C	H	U	C	H
1257	0.480	2	5	1	3	1	2	st3	2	4	4	d2	U	C	H	U	C	H
1258	2.835	2	5	2	2	1	2	st3	2	3	4	d2	C	U	O	C	U	B
1259	1.075	4	4	2	3	5	2	st3	3	3	4	d2	C	H	U	C	H	U
1260	0.203	2	4	2	2	3	1	st3	2	4	4	d1	C	U	O	C	U	H
1261	8.674	7	5	2	2	5	2	st3	2	3	4	d2	C	U	B	C	U	B
1262	1.677	2	5	2	2	2	2	st3	2	3	4	d2	C	L	U	C	L	U
1263	0.471	2	6	2	1	2	2	st3	2	2	4	d2	C	L	U	C	L	U
1264	1.130	2	4	2	2	4	2	st3	2	3	4	d2	C	H	U	C	H	U
1265	0.511	3	6	4	2	4	1	st1	1	3	1	d4	V	B	T	V	B	T
1266	0.526	3	5	2	2	1	1	st1	1	1	3	d3	V	B	T	V	B	T
1267	0.839	7	4	2	3	4	2	st3	2	3	4	d2	C	O	B	C	B	T
1268	0.350	3	6	4	2	4	1	st1	1	2	1	d4	V	B	T	V	B	T
1269	0.692	2	5	2	2	3	2	st3	2	4	4	d2	U	C	H	U	C	H
1270	0.316	2	5	2	1	1	2	st3	2	4	4	d2	C	U	N	C	U	N
1271	0.556	3	5	4	1	1	1	st1	1	1	3	d3	V	B	T	V	B	T
1272	0.425	7	5	2	2	5	2	st3	2	2	4	d2	C	H	B	C	H	B
1273	0.218	2	4	4	2	4	2	st3	2	1	4	d2	B	T	A	B	T	A
1274	1.026	3	6	2	1	2	2	st2	1	3	1	d4	C	T	B	C	T	B
1275	0.394	3	6	2	1	2	2	st1	1	2	1	d4	C	T	B	C	T	B
1276	20.810	2	4	2	2	4	2	st3	2	4	4	d2	C	U	H	C	U	H
1277	7.309	7	4	2	3	4	2	st3	2	2	4	d2	C	H	U	C	H	U
1278	0.712	3	6	2	2	4	1	st2	4	2	2	d3	B	A	C	B	A	C
1279	3.386	2	4	2	2	4	2	st3	2	4	4	d2	C	H	U	C	H	U
1280	0.277	2	5	2	3	3	2	st3	2	4	4	d2	U	C	H	U	C	H
1281	0.564	2	5	2	1	1	2	st3	2	1	4	d2	B	A	C	B	A	C

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
1282	6.015	3	6	2	2	4	2	st2	4	4	2	d3	C	H	U	C	H	U
1283	0.231	3	5	4	1	1	2	st1	1	1	3	d3	V	B	T	V	B	T
1284	0.282	3	6	2	2	4	1	st2	1	2	2	d5	B	A	C	B	A	C
1285	0.222	2	5	2	2	1	2	st3	2	1	4	d2	C	B	T	C	B	T
1286	13.407	2	5	2	2	1	2	st3	2	4	4	d2	C	U	N	C	U	N
1287	9.105	3	6	4	2	4	1	st2	1	2	2	d5	P	V	B	P	V	B
1288	0.841	2	5	3	2	1	2	st3	2	1	4	d2	C	B	T	C	B	T
1289	3.404	7	4	2	2	4	2	st3	2	3	4	d2	C	B	H	C	B	H
1290	0.991	2	4	2	3	4	2	st3	2	4	4	d2	C	H	U	C	H	U
1291	2.843	2	5	3	1	1	2	st3	2	1	4	d2	B	A	C	B	A	C
1292	0.852	3	6	2	2	4	2	st1	1	1	1	d4	V	B	T	V	B	T
1293	0.544	2	5	3	2	1	2	st3	2	4	4	d2	C	U	N	C	U	N
1294	0.453	3	6	4	1	2	2	st2	1	2	1	d4	B	T	C	B	T	C
1295	0.614	2	5	1	2	1	2	st3	2	4	4	d2	U	C	H	U	C	H
1296	0.509	2	4	4	2	4	2	st3	2	1	4	d2	B	T	A	B	T	A
1297	0.571	2	4	2	2	4	2	st3	2	1	4	d2	B	A	C	B	A	C
1298	0.644	2	5	2	2	1	1	st3	2	4	4	d2	C	U	N	C	U	N
1299	0.223	7	4	2	2	5	2	st3	2	3	4	d2	C	O	B	C	B	T
1300	0.304	3	6	2	1	2	2	st2	1	4	1	d4	B	T	C	B	T	C
1301	1.180	2	5	2	1	1	2	st3	2	4	4	d2	C	U	N	C	U	N
1302	1.197	2	4	4	2	4	1	st3	2	1	4	d2	B	T	A	B	T	A
1303	0.670	3	6	4	1	2	1	st2	1	2	1	d4	V	B	T	V	B	T
1304	1.044	3	6	4	2	4	1	st1	1	1	1	d4	P	V	B	P	V	B
1305	0.843	2	5	1	3	2	2	st3	2	4	4	d2	C	U	H	C	U	H
1306	0.279	3	6	2	2	1	1	st1	1	4	1	d4	B	A	C	B	A	C
1307	0.600	2	4	3	2	4	2	st3	2	1	4	d2	B	A	C	B	A	C
1308	0.982	7	4	2	3	4	2	st3	2	3	4	d2	C	B	H	C	B	H
1309	2.134	3	6	2	2	2	2	st2	1	4	1	d4	B	T	C	B	T	C
1310	2.470	3	6	4	2	1	1	st1	1	1	1	d4	P	V	B	P	V	B
1311	1.127	7	5	2	3	5	2	st3	2	3	4	d2	C	H	B	C	H	B
1312	0.213	2	5	2	2	1	1	st3	2	4	4	d2	A	C	L	A	C	L
1313	0.414	3	6	4	1	1	1	st1	1	4	1	d4	V	B	T	V	B	T
1314	1.959	2	5	2	1	1	2	st3	2	1	4	d2	C	L	T	C	L	T
1315	1.003	2	5	2	1	1	2	st3	2	4	4	d2	C	U	N	C	U	N
1316	0.426	2	5	4	2	4	1	st3	2	1	4	d2	B	A	C	B	A	C
1317	0.539	3	6	4	2	2	1	st2	1	4	1	d4	V	B	T	V	B	T
1318	5.375	2	5	3	2	4	2	st3	2	2	4	d2	C	O	U	C	U	T
1319	0.341	2	5	3	2	4	2	st3	2	1	4	d2	B	A	C	B	A	C
1320	1.996	3	6	4	1	1	1	st1	1	2	1	d4	P	V	B	P	V	B
1321	0.669	2	5	3	2	4	1	st3	2	1	4	d2	B	A	C	B	A	C

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
1322	0.651	5	4	2	1	2	2	st3	2	4	4	d2	U	C	H	U	C	H
1323	0.300	3	6	4	1	1	1	st1	1	2	1	d4	P	V	B	P	V	B
1324	1.145	2	5	3	2	1	2	st3	2	3	4	d2	C	U	O	C	U	N
1325	4.755	2	5	2	2	1	2	st3	2	3	4	d2	C	U	H	C	U	H
1326	0.384	2	5	4	2	1	1	st3	2	1	4	d2	B	A	C	B	A	C
1327	0.496	5	4	2	2	2	2	st3	2	4	4	d2	C	U	N	C	U	N
1328	0.902	3	6	4	2	1	1	st1	1	2	1	d4	P	V	B	P	V	B
1329	0.431	7	4	3	2	4	2	st3	2	3	4	d2	C	B	H	C	B	H
1330	6.706	2	4	2	2	4	2	st3	2	4	4	d2	C	U	H	C	U	H
1331	0.471	2	5	3	2	1	2	st3	2	2	4	d2	C	O	U	C	U	N
1332	0.296	3	6	2	2	2	2	st2	1	3	1	d4	V	B	T	V	B	T
1333	0.393	2	5	2	2	1	1	st3	2	1	4	d2	B	A	C	B	A	C
1334	0.333	2	4	3	2	4	1	st3	2	1	4	d2	B	T	A	B	T	A
1335	2.893	5	4	2	2	2	2	st3	2	3	4	d2	U	C	N	U	C	N
1336	0.227	7	4	2	2	5	2	st3	2	3	4	d2	C	O	B	C	B	T
1337	0.618	2	4	3	2	4	2	st3	2	1	4	d2	B	T	V	B	T	V
1338	4.208	2	5	3	2	4	2	st3	2	1	4	d2	B	T	V	B	T	V
1339	3.669	2	5	3	2	4	2	st3	2	3	4	d2	C	U	O	C	U	T
1340	37.441	2	5	2	2	1	2	st3	2	3	4	d2	C	U	H	C	U	H
1341	3.753	5	4	2	2	2	2	st3	2	4	4	d2	C	U	N	C	U	N
1342	1.055	4	5	3	2	4	2	st3	2	3	4	d2	C	O	U	C	U	T
1343	1.523	3	6	4	2	1	1	st1	1	2	1	d4	P	V	B	P	V	B
1344	0.454	5	4	2	2	1	2	st3	2	4	4	d2	C	U	H	C	U	H
1345	0.301	3	6	2	2	4	1	st2	4	2	2	d3	A	C	B	A	C	B
1346	0.724	4	5	4	2	4	1	st3	2	2	4	d2	A	B	T	A	B	T
1347	0.244	5	4	2	2	2	2	st3	2	2	4	d2	C	U	N	C	U	N
1348	7.791	5	4	2	2	1	2	st3	2	2	4	d2	C	U	H	C	U	H
1349	0.470	5	4	2	1	1	2	st3	2	2	4	d2	C	U	H	C	U	H
1350	0.312	4	5	2	2	4	2	st3	2	3	4	d2	C	O	U	C	U	N
1351	1.300	2	5	3	2	1	1	st3	2	3	4	d2	V	B	T	V	B	T
1352	0.214	5	4	2	2	1	2	st3	2	3	4	d2	C	U	H	C	U	H
1353	0.334	3	6	2	3	4	2	st2	4	4	2	d3	C	U	M	C	U	H
1354	4.931	4	5	2	3	4	2	st3	2	2	4	d2	C	O	U	C	U	T
1355	0.318	2	5	3	2	4	1	st3	2	1	4	d2	C	L	T	C	L	T
1356	8.042	4	5	3	2	4	2	st3	2	2	4	d2	C	O	U	C	U	T
1357	0.400	4	5	2	3	4	2	st3	2	3	4	d2	C	O	U	C	U	N
1358	0.376	3	6	2	3	4	2	st2	4	2	2	d3	H	C	U	H	C	U
1359	0.564	3	6	3	2	1	1	st2	1	3	1	d4	V	B	T	V	B	T
1360	5.307	2	5	3	2	1	2	st3	2	3	4	d2	C	B	T	C	B	T

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
1361	0.676	2	4	2	2	4	2	st3	2	2	4	d2	C	O	U	C	U	T
1362	1.414	4	5	2	2	4	2	st3	2	2	4	d2	C	B	T	C	B	T
1363	16.406	2	4	2	3	4	2	st3	2	2	4	d2	C	H	U	C	H	U
1364	1.204	5	4	2	3	2	2	st3	2	4	4	d2	H	U	C	H	U	C
1365	2.847	3	6	2	2	1	2	st2	1	4	1	d4	V	B	T	V	B	T
1366	2.403	5	4	2	3	1	2	st3	2	4	4	d2	H	U	C	H	U	C
1367	1.290	2	4	4	2	4	1	st3	2	1	4	d2	B	T	A	B	T	A
1368	0.363	2	5	2	1	1	1	st3	2	3	4	d2	A	C	B	A	C	B
1369	1.092	3	6	2	2	1	2	st2	1	4	1	d4	C	U	N	C	U	N
1370	2.952	2	5	3	2	1	2	st3	2	4	4	d2	C	U	N	C	U	N
1371	0.329	2	4	2	3	4	2	st3	2	4	4	d2	C	U	H	C	U	H
1372	0.657	2	5	3	2	1	2	st3	2	3	4	d2	A	C	B	A	C	B
1373	0.428	2	4	3	2	4	1	st2	2	1	4	d2	A	C	B	A	C	B
1374	0.517	2	4	3	2	4	1	st3	2	1	4	d2	B	T	A	B	T	A
1375	1.196	2	4	4	2	4	1	st2	2	1	4	d2	B	G	T	B	G	T
1376	4.200	2	5	2	2	4	2	st3	2	3	4	d2	C	U	N	C	U	N
1377	1.010	4	5	2	1	1	2	st2	2	3	5	d2	C	O	U	C	U	B
1378	12.488	5	4	2	2	1	2	st3	2	3	4	d2	C	U	H	C	U	H
1379	0.258	4	5	2	2	1	2	st2	2	2	5	d2	C	O	U	C	U	B
1380	2.290	4	5	2	2	1	2	st2	2	3	5	d2	C	O	U	C	U	T
1381	0.278	3	6	2	2	1	1	st2	1	4	1	d4	B	T	C	B	T	C
1382	0.823	2	4	3	2	4	2	st3	2	1	4	d2	B	T	A	B	T	A
1383	0.425	3	6	4	2	1	1	st2	2	4	1	d4	B	T	A	B	T	A
1384	0.933	2	5	2	2	1	2	st3	2	3	4	d2	A	C	B	A	C	B
1385	0.328	3	6	4	2	1	2	st2	2	4	1	d4	B	T	A	B	T	A
1386	6.891	2	4	2	3	4	2	st3	2	4	4	d2	C	U	H	C	U	H
1387	0.377	2	4	2	2	4	2	st3	2	2	4	d2	C	U	N	C	U	N
1388	2.948	5	4	2	2	1	2	st3	2	4	4	d2	C	U	H	C	U	H
1389	0.494	3	6	3	2	1	1	st2	2	4	1	d4	B	T	A	B	T	A
1390	0.484	2	5	2	3	4	2	st3	2	3	4	d2	C	U	N	C	U	N
1391	3.659	2	5	3	2	1	2	st3	2	4	4	d2	A	C	U	A	C	U
1392	0.593	2	4	3	2	4	2	st2	2	1	4	d2	B	T	A	B	T	A
1393	1.942	3	6	3	2	1	2	st2	2	4	1	d4	B	T	A	B	T	A
1394	1.575	1	4	2	3	1	2	st3	2	4	4	d2	C	U	H	C	U	H
1395	0.235	2	5	2	3	1	2	st3	2	4	4	d2	U	C	H	U	C	H
1396	6.095	2	5	2	2	1	2	st3	2	4	4	d2	U	C	H	U	C	H
1397	3.454	4	5	2	1	1	2	st2	2	3	5	d2	C	M	H	C	H	U
1398	0.816	5	4	1	3	1	2	st3	2	4	4	d2	H	U	C	H	U	C
1399	0.579	3	6	2	2	4	2	st2	1	2	2	d4	B	T	A	B	T	A
1400	0.534	2	5	2	1	1	2	st3	2	4	4	d2	C	U	O	C	U	T

Table 35 (Contd...)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
1401	1.089	3	6	2	1	1	1	st2	1	4	1	d4	B	T	A	B	T	A
1402	0.213	2	5	2	2	1	2	st3	2	4	4	d2	C	U	O	C	U	T
1403	3.797	1	4	2	3	1	2	st3	2	3	4	d2	C	U	H	C	U	H
1404	1.624	1	4	2	2	1	2	st3	2	3	4	d2	C	U	H	C	U	H
1405	1.376	1	4	1	3	1	2	st3	2	4	4	d2	H	U	C	H	U	C
1406	0.810	2	4	3	2	4	2	st3	2	1	4	d2	B	T	A	B	T	A
1407	0.334	5	4	1	2	1	2	st3	2	4	4	d2	H	U	C	H	U	C
1408	0.714	2	5	2	2	4	2	st3	2	2	4	d2	C	U	N	C	U	N
1409	0.722	3	6	2	1	1	2	st2	1	4	1	d4	B	T	A	B	T	A
1410	1.878	2	5	2	3	4	2	st3	2	3	4	d2	C	U	N	C	U	N
1411	1.285	2	4	3	2	4	2	st3	2	3	4	d2	A	C	U	A	C	U
1412	9.186	4	5	2	2	1	2	st2	2	2	5	d2	C	O	U	C	U	T
1413	0.239	2	5	2	1	1	2	st3	2	4	4	d2	C	U	H	C	U	H
1414	10.363	2	4	2	3	4	2	st3	2	3	4	d2	C	U	H	C	U	H
1415	2.460	2	5	2	2	1	2	st3	2	2	4	d2	C	U	N	C	U	N
1416	3.454	3	6	2	2	1	2	st2	1	3	1	d4	B	A	T	B	A	T
1417	0.420	3	6	2	1	1	2	st2	1	4	1	d4	A	C	T	A	C	T
1418	1.265	2	4	3	2	4	2	st3	2	4	4	d2	A	C	U	A	C	U
1419	0.843	3	6	2	2	1	2	st2	1	4	1	d4	A	B	T	A	B	T
1420	9.928	4	5	2	3	4	2	st3	2	4	4	d2	H	C	U	H	C	U
1421	1.635	2	5	3	2	1	2	st3	2	3	4	d2	A	C	U	A	C	U
1422	9.276	2	5	2	2	1	2	st3	2	3	4	d2	C	U	N	C	U	N
1423	1.085	3	6	2	1	1	2	st2	1	3	1	d4	B	A	T	B	A	T
1424	0.246	2	5	2	2	1	2	st3	2	3	4	d2	C	U	N	C	U	N
1425	0.555	2	4	3	2	4	2	st3	2	1	4	d2	A	C	L	A	C	L
1426	0.313	3	6	4	1	1	2	st1	1	1	1	d4	V	B	T	V	B	T
1427	1.549	2	4	2	2	4	2	st3	2	3	4	d2	C	U	H	C	U	H
1428	0.312	2	4	4	2	4	2	st3	2	1	4	d2	A	C	L	A	C	L
1429	0.706	4	5	2	1	1	2	st2	2	2	5	d2	C	O	U	C	U	T
1430	0.368	4	5	2	2	1	2	st2	2	3	5	d2	C	O	U	C	U	T
1431	12.013	3	6	4	1	1	1	st1	1	1	1	d4	P	V	B	P	V	B
1432	4.454	2	5	3	2	1	2	st3	2	2	4	d2	C	U	N	C	U	N
1433	0.225	4	5	2	2	4	2	st3	2	4	4	d2	C	B	T	C	B	T
1434	0.583	2	5	2	3	1	2	st3	2	3	4	d2	C	U	N	C	U	N
1435	15.139	2	5	3	2	1	2	st3	2	3	4	d2	C	U	O	C	U	L
1436	0.513	4	5	3	2	4	2	st3	2	4	4	d2	C	B	T	C	B	T
1437	5.649	2	4	2	3	4	2	st3	2	2	4	d2	C	U	H	C	U	H
1438	0.436	2	4	2	2	1	2	st3	2	3	4	d2	C	U	N	C	U	N
1439	0.470	2	5	2	1	1	1	st3	2	3	4	d2	B	A	C	B	A	C

Table 35 (Contd…)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
1440	0.546	2	4	2	2	1	2	st3	2	2	4	d2	C	U	O	C	U	T
1441	1.424	2	4	2	3	1	2	st3	2	2	4	d2	C	U	H	C	U	H
1442	0.435	3	6	4	1	1	2	st1	1	1	1	d4	V	B	T	V	B	T
1443	1.402	2	5	2	1	1	2	st3	2	3	4	d2	A	C	B	A	C	B
1444	0.532	3	6	2	1	1	2	st2	1	3	1	d4	B	T	A	B	T	A
1445	0.434	1	4	1	3	1	2	st3	2	3	4	d2	H	U	C	H	U	C
1446	0.565	2	5	4	1	1	1	st3	2	3	4	d2	C	U	T	C	U	T
1447	0.355	2	5	4	2	1	2	st3	2	2	4	d2	A	C	T	A	C	T
1448	6.697	5	4	2	2	1	2	st3	2	2	4	d2	C	U	T	C	U	T
1449	0.383	1	4	1	2	1	2	st3	2	3	4	d2	H	U	C	H	U	C
1450	1.023	2	5	3	2	1	2	st3	2	1	4	d2	A	C	T	A	C	T
1451	12.168	3	6	4	2	1	1	st1	1	1	1	d4	P	V	B	P	V	B
1452	0.414	3	6	4	2	1	1	st1	1	3	1	d4	V	B	T	V	B	T
1453	0.448	3	6	4	2	1	2	st1	1	3	1	d4	V	B	T	V	B	T
1454	0.711	3	6	2	2	1	2	st2	1	2	1	d4	V	B	T	V	B	T
1455	2.093	2	5	3	2	1	2	st3	2	3	4	d2	C	B	T	C	B	T
1456	0.331	2	5	4	2	1	1	st3	2	1	4	d2	C	B	T	C	B	T
1457	0.742	4	5	2	2	1	2	st2	2	3	5	d2	C	B	R	C	B	R
1458	0.457	4	5	2	2	1	2	st2	2	3	5	d2	C	B	R	C	B	R
1459	1.959	5	4	2	2	1	2	st3	2	3	4	d2	C	U	T	C	U	T
1460	0.732	5	5	2	2	1	2	st3	2	3	4	d1	A	C	L	A	C	L
1461	2.514	4	6	2	2	1	2	st2	2	2	5	d2	C	B	R	C	B	R
1462	0.313	4	5	2	1	1	2	st2	2	3	5	d2	C	B	R	C	B	R
1463	5.412	3	6	2	1	1	2	st2	1	3	5	d2	C	B	T	C	B	T
1464	0.265	3	6	2	2	1	2	st2	1	3	5	d2	C	B	T	C	B	T
1465	0.348	3	6	4	2	1	1	st1	1	3	1	d4	B	T	A	B	T	A
1466	0.413	5	4	2	1	1	2	st3	2	3	4	d2	C	U	T	C	U	T
1467	0.431	3	6	3	2	1	2	st1	1	3	1	d4	B	T	A	B	T	A
1468	0.315	3	6	2	2	1	2	st1	1	1	1	d4	V	B	T	V	B	T
1469	4.589	4	6	2	2	1	2	st2	2	3	5	d2	A	C	L	A	C	L
1470	0.363	3	6	4	2	1	2	st1	1	3	1	d4	V	B	T	V	B	T
1471	6.991	5	5	3	2	1	2	st3	2	3	4	d1	C	U	N	C	U	N
1472	0.720	5	5	3	2	1	1	st3	2	3	4	d1	B	A	C	B	A	C
1473	1.867	2	5	3	2	1	2	st3	2	3	4	d2	C	U	N	C	U	N
1474	1.318	2	5	3	1	1	2	st3	2	3	4	d2	A	C	B	A	C	B
1475	1.088	4	6	2	1	1	2	st2	2	3	5	d2	A	C	L	A	C	L
1476	0.351	3	6	4	2	1	2	st1	1	1	1	d4	P	V	B	P	V	B
1477	0.510	3	6	4	1	1	2	st1	1	1	1	d4	V	B	T	V	B	T
1478	0.394	3	6	3	2	1	1	st1	1	1	1	d4	V	B	T	V	B	T

Table 35 (Contd...)

LMU ID*	AREA (Ha)	BIOPHYSICAL FACTORS*											INITIAL CROP SUT*			FINAL CROP SUT*		
		T	D	P	E	N	G	S	R	L	H	SD	S1	S2	S3	S1	S2	S3
1479	7.230	2	6	3	2	1	2	st3	1	1	4	d1	B	A	C	B	A	C
1480	0.360	2	6	3	2	1	1	st3	1	1	4	d1	B	A	C	B	A	C
1481	5.628	2	6	3	2	1	2	st3	1	3	4	d1	C	U	T	C	U	T
1482	0.489	3	6	3	2	1	1	st1	1	1	1	d4	V	B	T	V	B	T
1483	4.137	2	6	3	1	1	2	st3	1	1	4	d1	B	T	A	B	T	A
1484	0.319	5	5	3	3	1	2	st3	2	3	4	d1	C	U	N	C	U	N
1485	0.285	3	6	2	2	1	2	st2	1	3	5	d2	B	T	A	B	T	A
1486	0.405	3	6	2	1	1	2	st1	1	3	1	d4	V	B	T	V	B	T
1487	0.911	2	6	2	3	1	2	st3	1	4	4	d1	C	U	H	C	U	H
1488	2.470	1	5	2	3	1	3	st3	2	4	4	d1	H	U	C	H	U	C
1489	0.624	2	6	2	3	1	3	st3	1	4	4	d1	H	U	C	H	U	C
1490	0.714	2	6	2	2	1	2	st3	1	3	4	d1	C	U	T	C	U	T
1491	0.295	2	6	2	2	1	2	st3	1	1	4	d1	C	T	U	C	T	U
1492	0.293	1	5	2	3	1	4	st3	2	4	4	d1	H	U	C	H	U	C
1493	0.251	2	6	3	1	1	2	st3	1	3	4	d1	B	T	A	B	T	A
1494	0.335	1	5	2	3	1	4	st3	2	4	4	d1	H	U	C	H	U	C
1495	1.325	2	6	2	2	1	2	st3	1	4	4	d1	C	B	T	C	B	T
1496	2.758	1	5	2	3	1	3	st3	2	4	4	d1	H	U	C	H	U	C
1497	0.205	2	6	2	1	1	2	st3	1	3	4	d1	C	U	T	C	U	T
1498	5.664	1	5	2	4	1	3	st3	2	4	4	d1	H	U	C	H	U	C
1499	1.537	2	6	2	1	1	2	st3	1	4	4	d1	U	C	T	U	C	T
1500	1.568	1	5	2	2	1	3	st3	2	4	4	d1	H	U	C	H	U	C
1501	0.274	1	5	2	2	1	2	st3	2	4	4	d1	C	U	T	C	U	T
1502	0.788	1	5	2	1	1	2	st3	2	4	4	d1	C	U	T	C	U	T
1503	2.542	1	5	2	4	1	3	st3	2	3	4	d1	H	U	C	H	U	C
1504	1.516	1	5	2	2	1	3	st3	2	6	4	d1	H	U	C	H	U	C
1505	0.982	1	5	2	3	1	3	st3	2	6	4	d1	H	U	C	H	U	C
1506	0.402	1	5	2	4	1	3	st3	2	6	4	d1	H	U	C	H	U	C
1507	2.534	1	5	2	1	1	2	st3	2	6	4	d1	H	U	C	H	U	C
1508	0.348	1	5	2	1	1	3	st3	2	6	4	d1	H	U	C	H	U	C

LMU ID - Land mapping unit identification number

INITIAL CROP SUT - Recommended crop suitability on the basis of biophysical factors

FINAL CROP SUT - Recommended crop suitability after consideration of socio-economic factors also

Details of Biophysical Factors

T - Soil texture

1 - clay loam
2 - gravelly clay loam
3 - sandy clay
4 - sandy loam
5 - gravelly loam
6 - sandy clay loam
7 - gravelly sandy clay loam

D - Soil depth

2 - 25 to 50 cm
3 - 50 to 75 cm
4 - 75 to 100 cm
5 - 100 to 150 cm
6 - > 150 cm

P - Physiography

1 - Submit
2 - Side slope
3 - Foot slope
4 - Valley

E - Elevation

1 - < 20 m MSL
2 - 20 to 50 m MSL
3 - 50 to 80 m MSL
4 - 80 to 110 m MSL
5 - 110 to 140 m MSL

N - Status of Major Nutrients

	N (% C)	P (kg/ha)	K (kg/ha)
1	0.60	8.7	109
2	0.22	12	270
3	0.05	14	82
4	0.02	> 60	92
5	0.20	21	416
6	0.20	> 60	208
7	0.14	19	320
8	0.22	48	333
9	0.07	56	121
10	0.12	> 60	79
11	0.22	50	150
12	0.24	> 60	95

G - Ground water potential

1 - Good
2 - Moderate
3 - Poor
4 - Very poor

S - Surface stoniness / gravel

St1 - < 3 % gravels
St2 - 3 to 15 % gravels
St3 - 15 to 40 % gravels
St4 - 40 to 75 % gravels
St5 - > 75 % gravels

R - Erosion status

1 - Slight
2 - Moderate
3 - Severe
4 - Very severe

L - Slope of land

1 - 0 to 3 %
2 - 3 to 8 %
3 - 8 to 15 %
4 - 15 to 35 %
5 - 35 to 50 %
6 - > 50 %

H - Soil pH

1 - 4.5 to 5.0
2 - 5.1 to 5.5
3 - 5.6 to 6.0
4 - 6.1 to 6.5
5 - 6.6 to 7.0

SD - Soil drainage

d1 - Excessively drained
d2 - Well drained
d3 - Mod. Well drained
d4 - Imperfectly drained
d5 - Poorly drained

Crop Codes

P - Paddy
C - Coconut
U - Rubber
H - Cashew
T - Tapioca
M - Mango
B - Banana
R - Pepper
A - Arecanut
S - Sapota
I - Pineapple
W - Pulses
V - Vegetables
G - Ginger
O - Cocoa
L - Clove
N - Nutmeg

Example of LMU ID No. 1

Texture	-	Gravelly loam (2)
Depth	-	75-100 cm (4)
Physiography	-	submit (1)
Elevation	-	80-110 m above MSL (4)
Nutrient status(N:P:K)	-	0.22:50:150 (11)
Ground water potential	-	moderate (2)
Stonniness	-	15 % to 40 % gravels (st3)
Erosion	-	Severe (3)
Slope	-	15 % to 35 % (4)
Soil pH	-	6.1 to 6.5 (4)
Soil drainage	-	excessively drained (d1)

Initial crop suitability

S1 - Cashew (H)
S2 - Coconut (C)
S3 - Rubber (U)

Final crop suitability

S1 - Cashew (H)
S2 - Coconut (C)
S3 - Rubber (U)

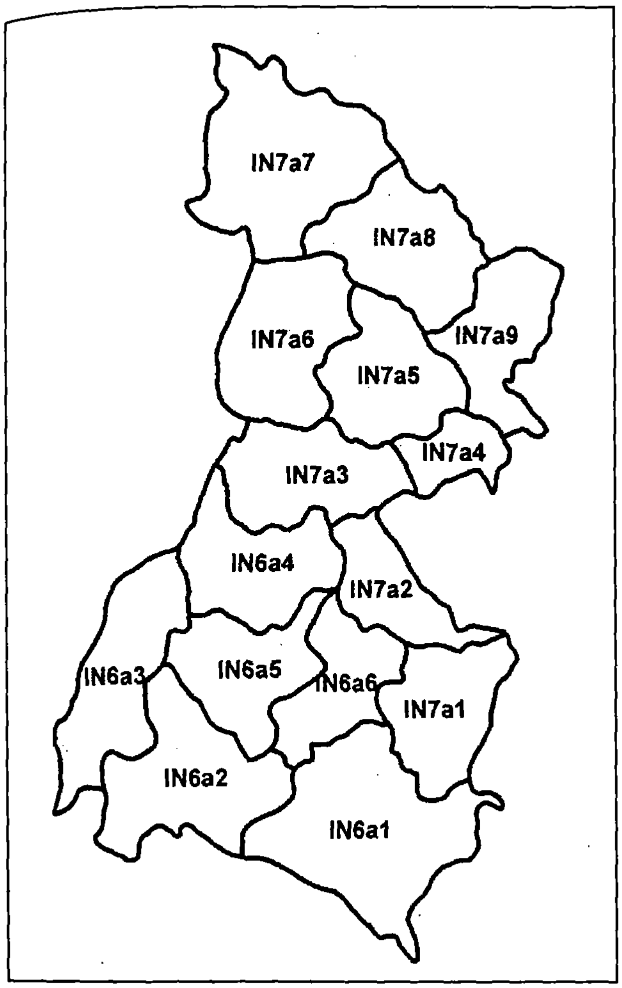

Fig. Nos.	Micro watershed codes
21.1	1N7a7
21.2	1N7a8
21.3	1N7a9
21.4	1N7a6
21.5	1N7a5
21.6	1N7a4
21.7	1N7a3
21.8	1N7a2
21.9	1N7a1
21.10	1N6a4
21.11	1N6a3
21.12	1N6a5
21.13	1N6a6
21.14	1N6a2
21.15	1N6a1

Fig. 21. Index map with micro watershed wise distribution of LMUs in the Aruvipuram watershed

Note : For convenience of presentation in this thesis, the single map of entire Aruvipuram watershed on 1:10000 scale has been reduced to 1:20000 scale and presented as 15 sheets (Figs. 21.1 to 21.15) from north to south on micro watershed basis in as per the index map.

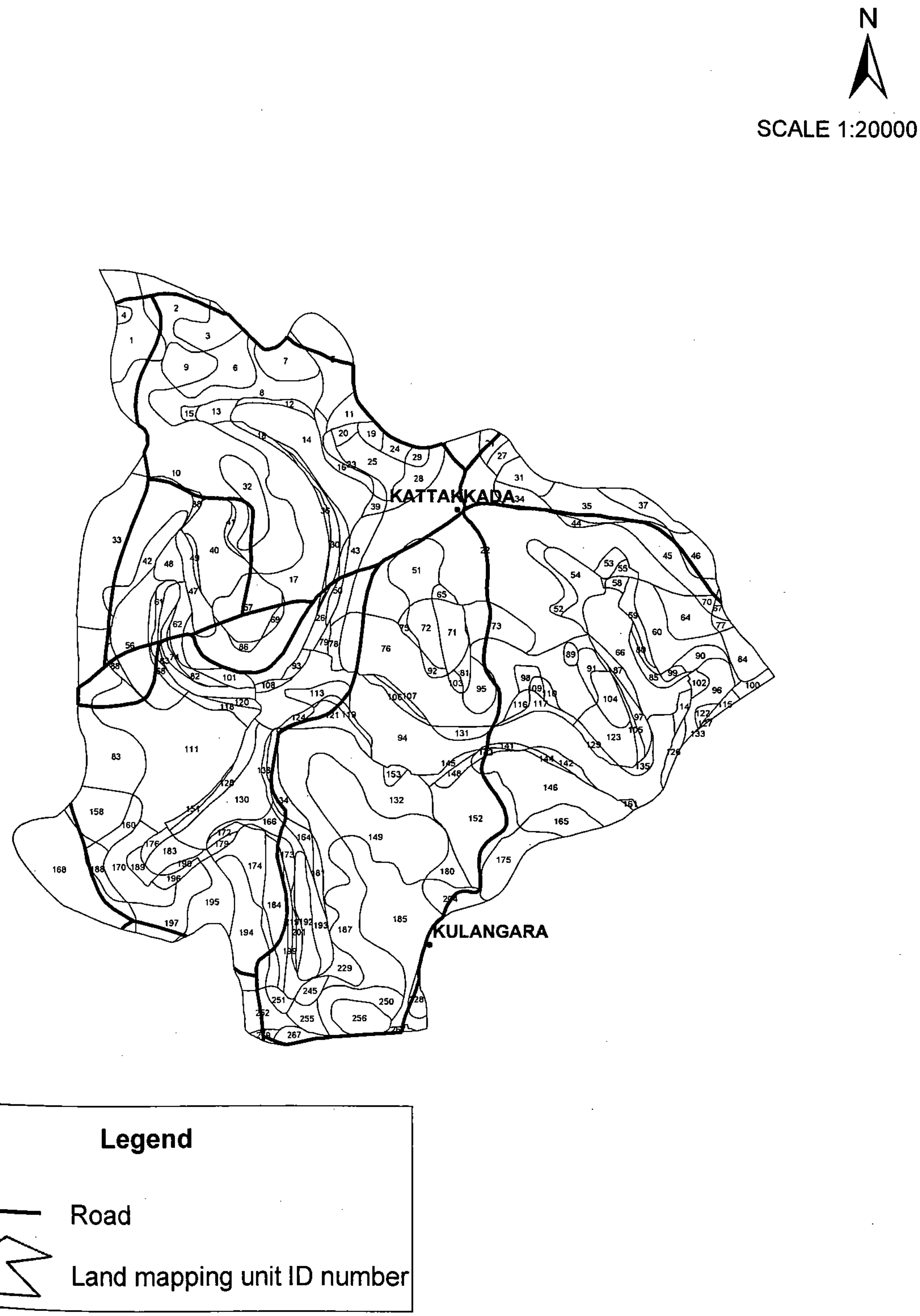

Fig 21.1 Land mapping units of microwatershed 1N7a7
in spatial crop suitability model

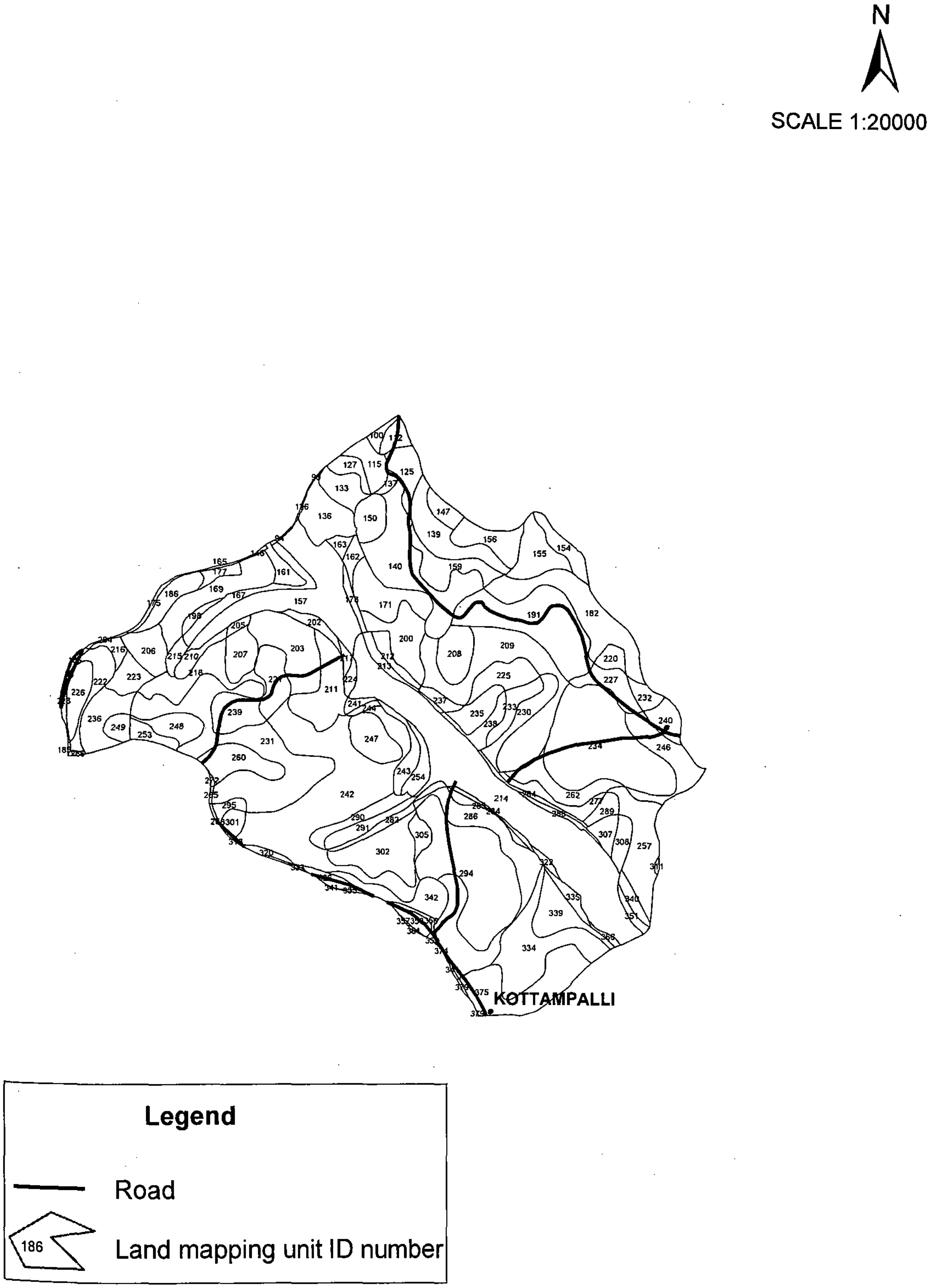

Fig 21.2 Land mapping units of microwatershed 1N7a8
in spatial crop suitability model

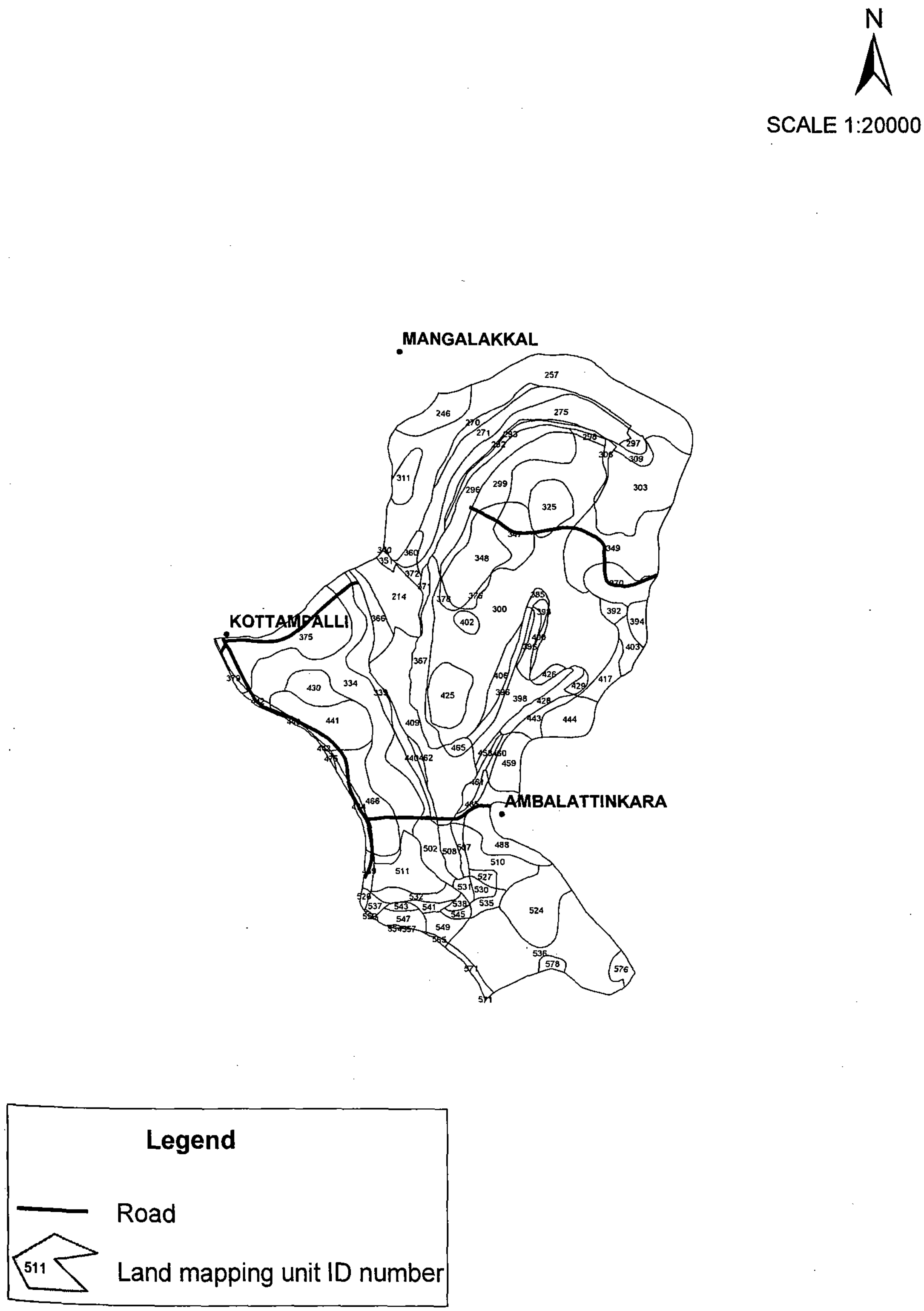

Fig 21.3 Land mapping units of microwatershed 1N7a9
in spatial crop suitability model

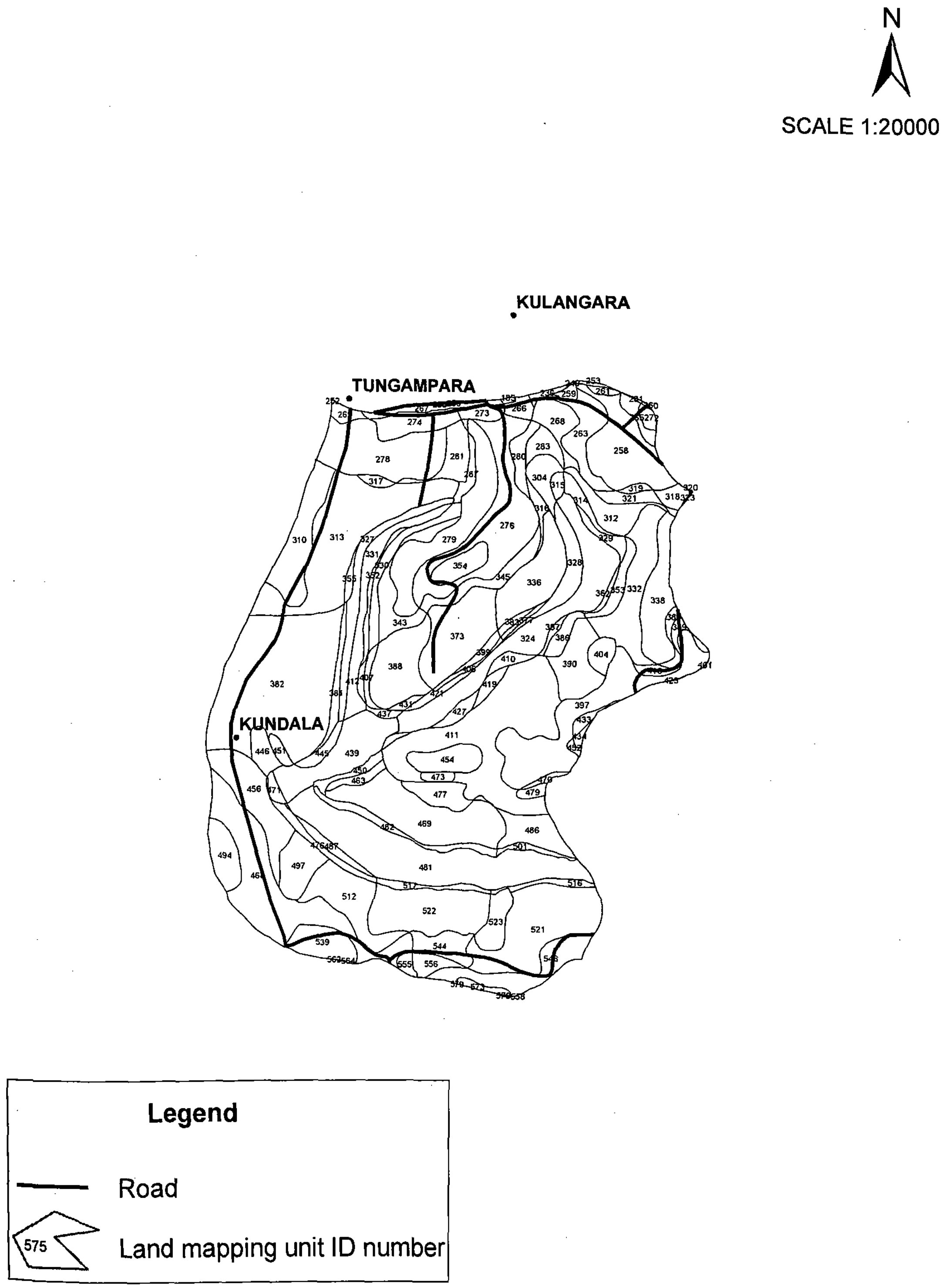

Fig 21.4 Land mapping units of microwatershed 1N7a6
in spatial crop suitability model

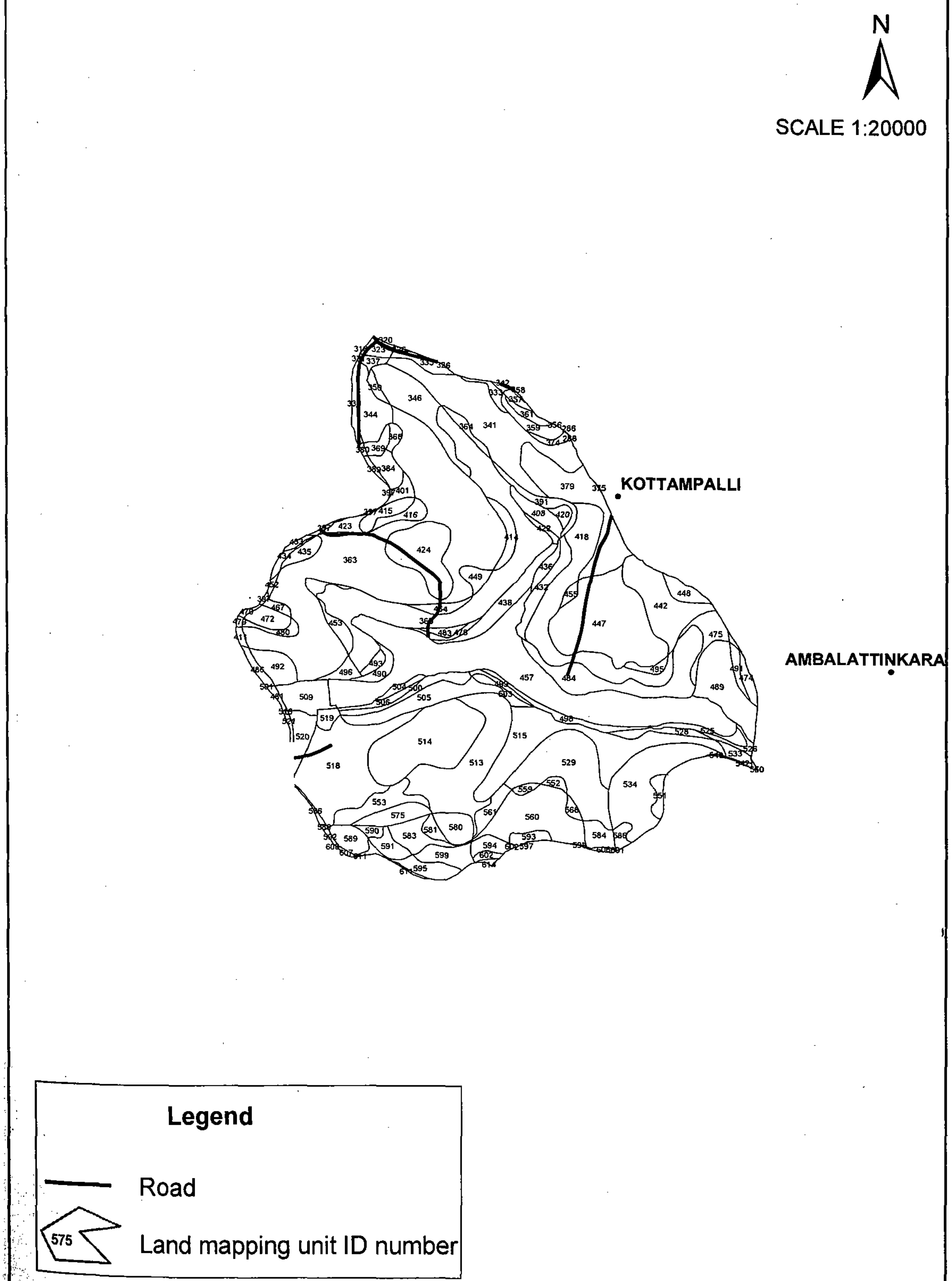

Fig 21.5 Land mapping units of microwatershed 1N7a5 in spatial crop suitability model

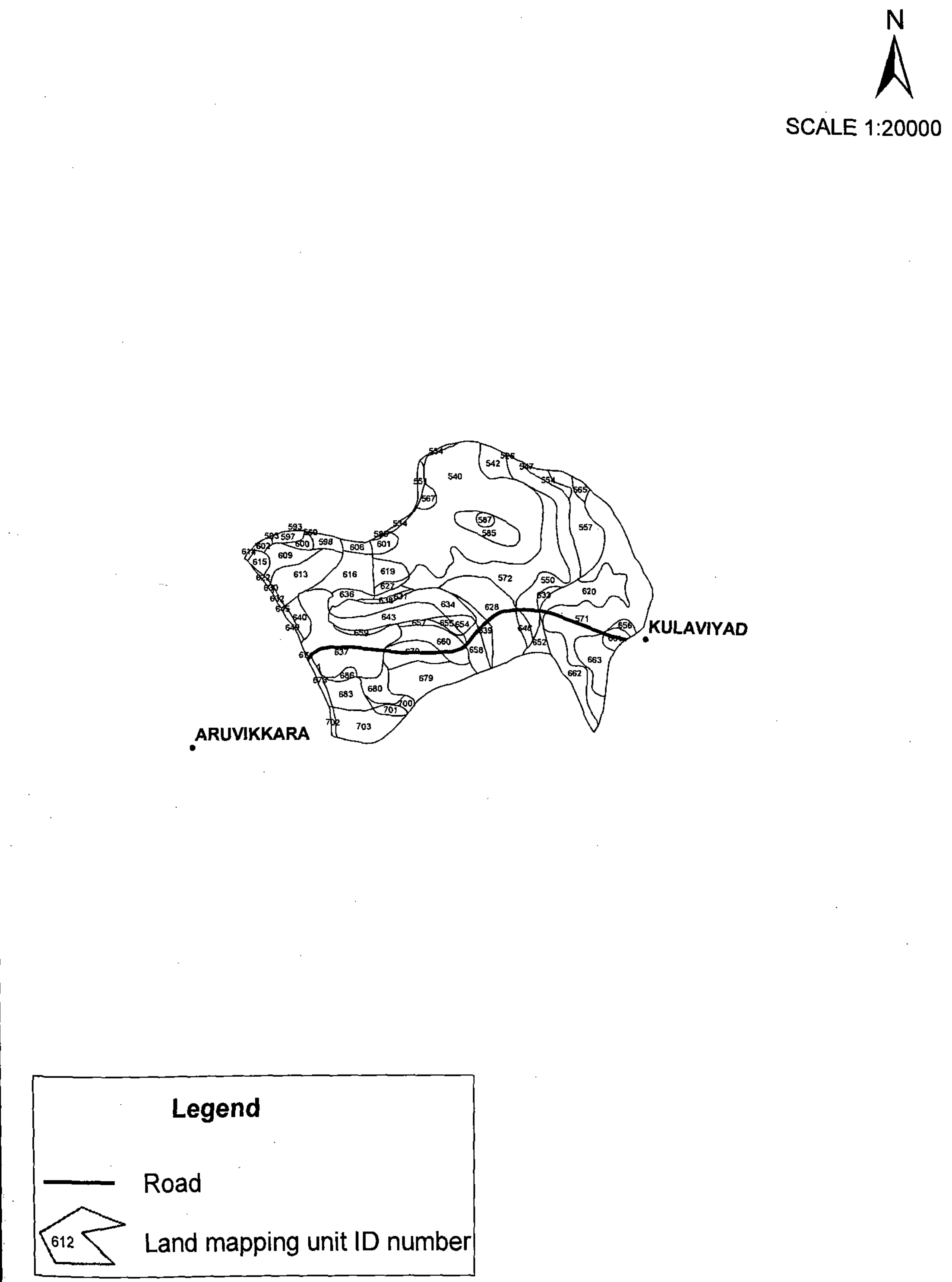

Fig 21.6 Land mapping units of microwatershed 1N7a4
in spatial crop suitability model

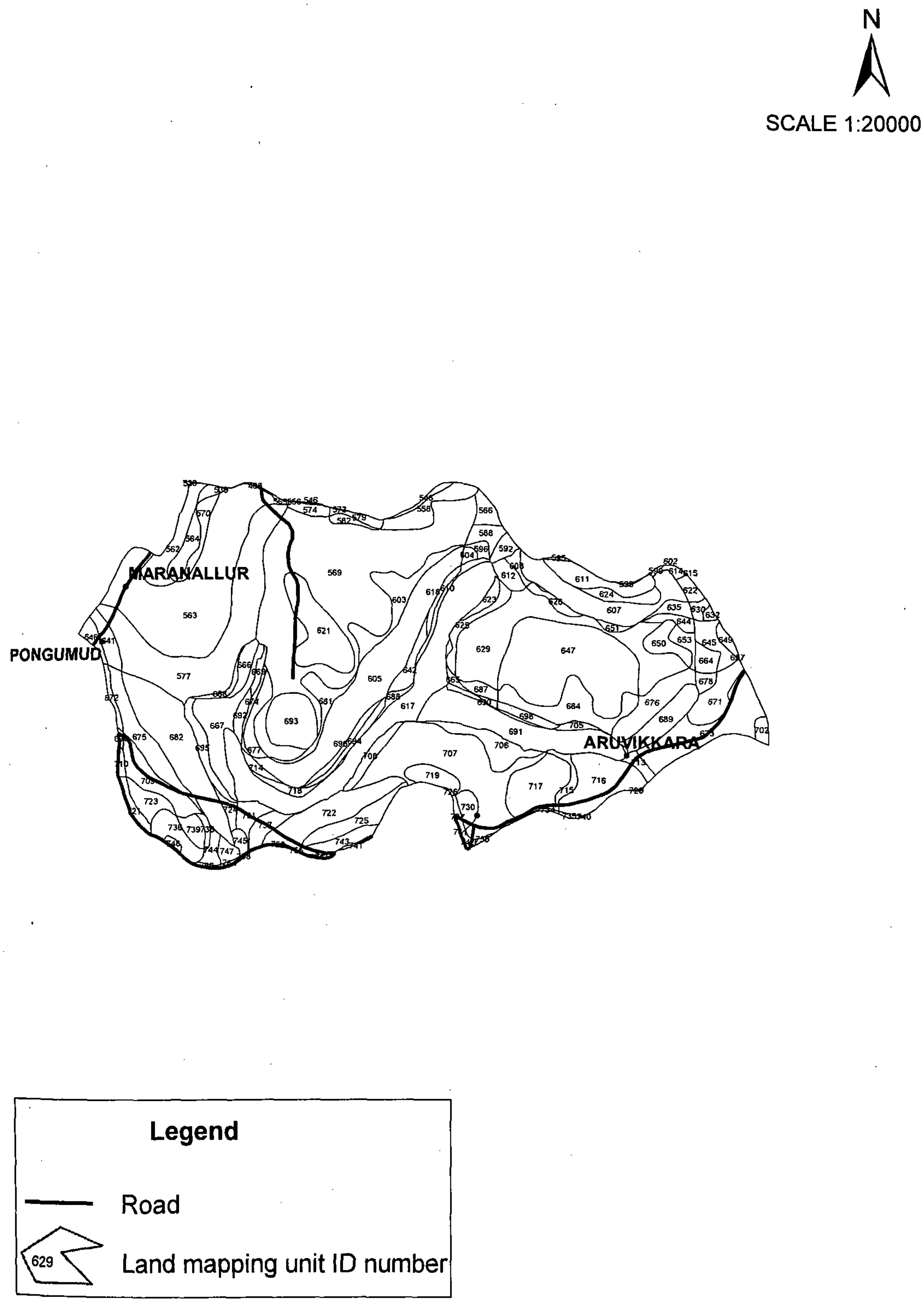

Fig 21.7 Land mapping units of microwatershed 1N7a3
in spatial crop suitability model

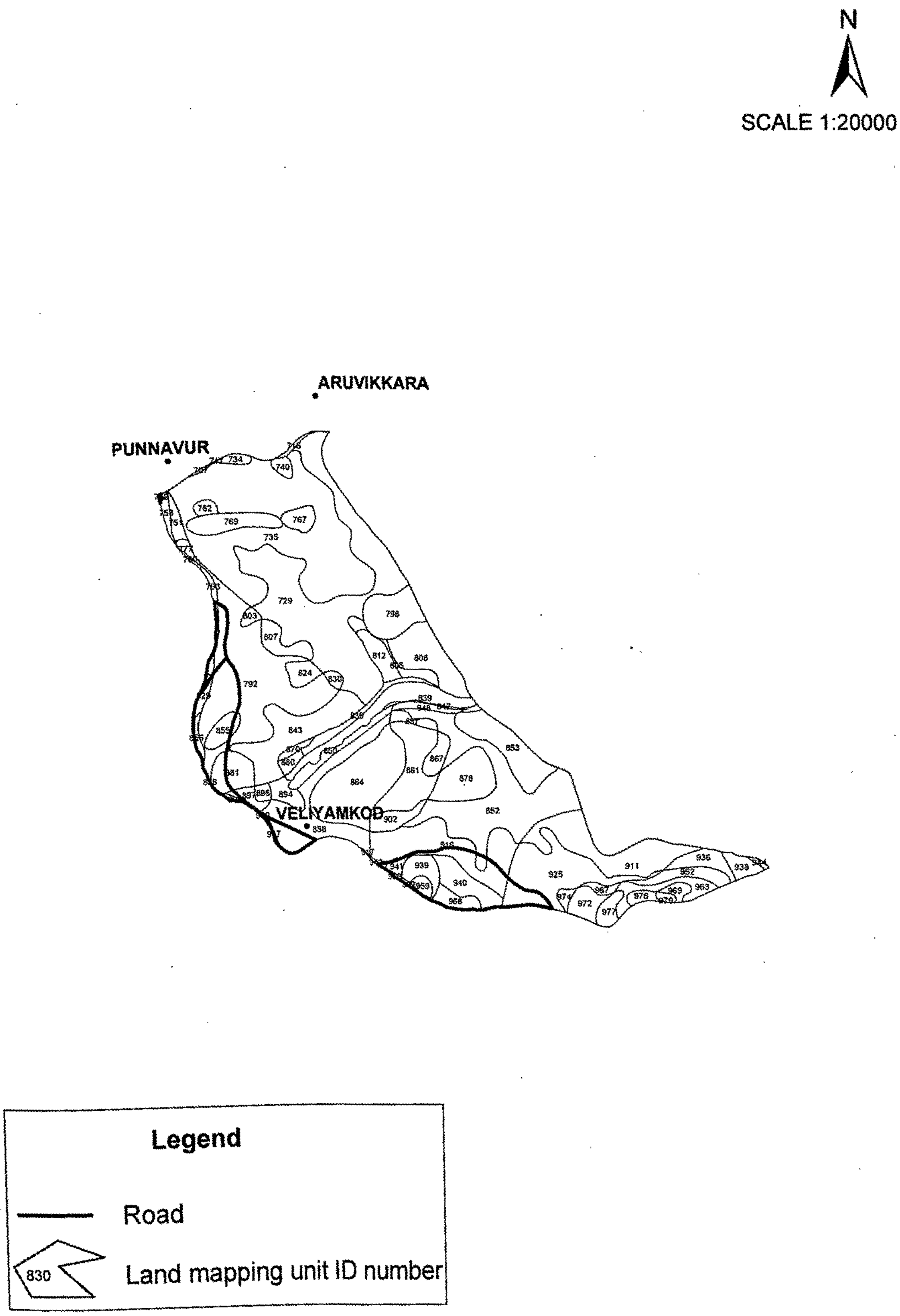

Fig 21.8 Land mapping units of microwatershed 1N7a2
in spatial crop suitability model

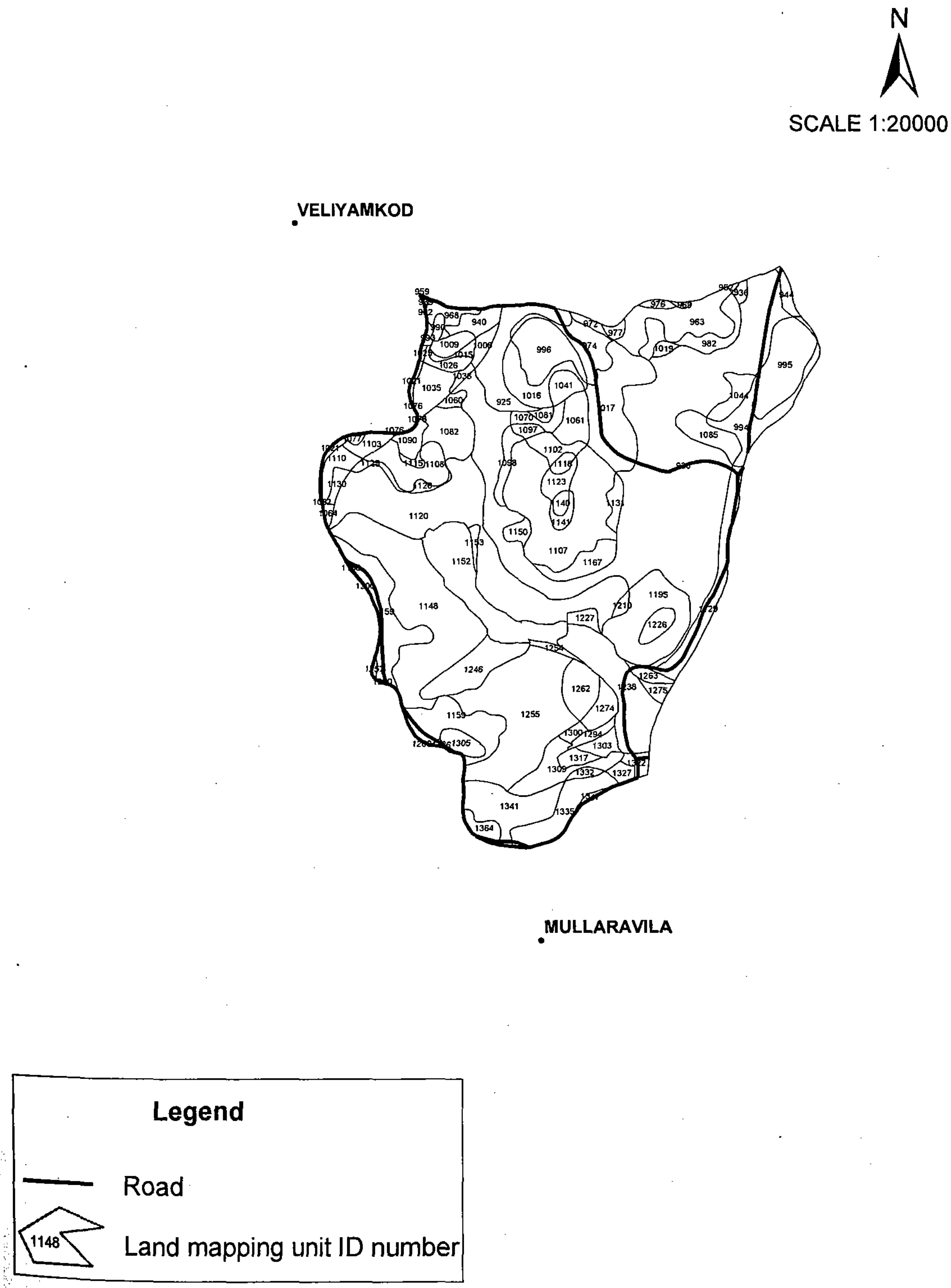

Fig 21.9 Land mapping units of microwatershed 1N7a1 in spatial crop suitability model

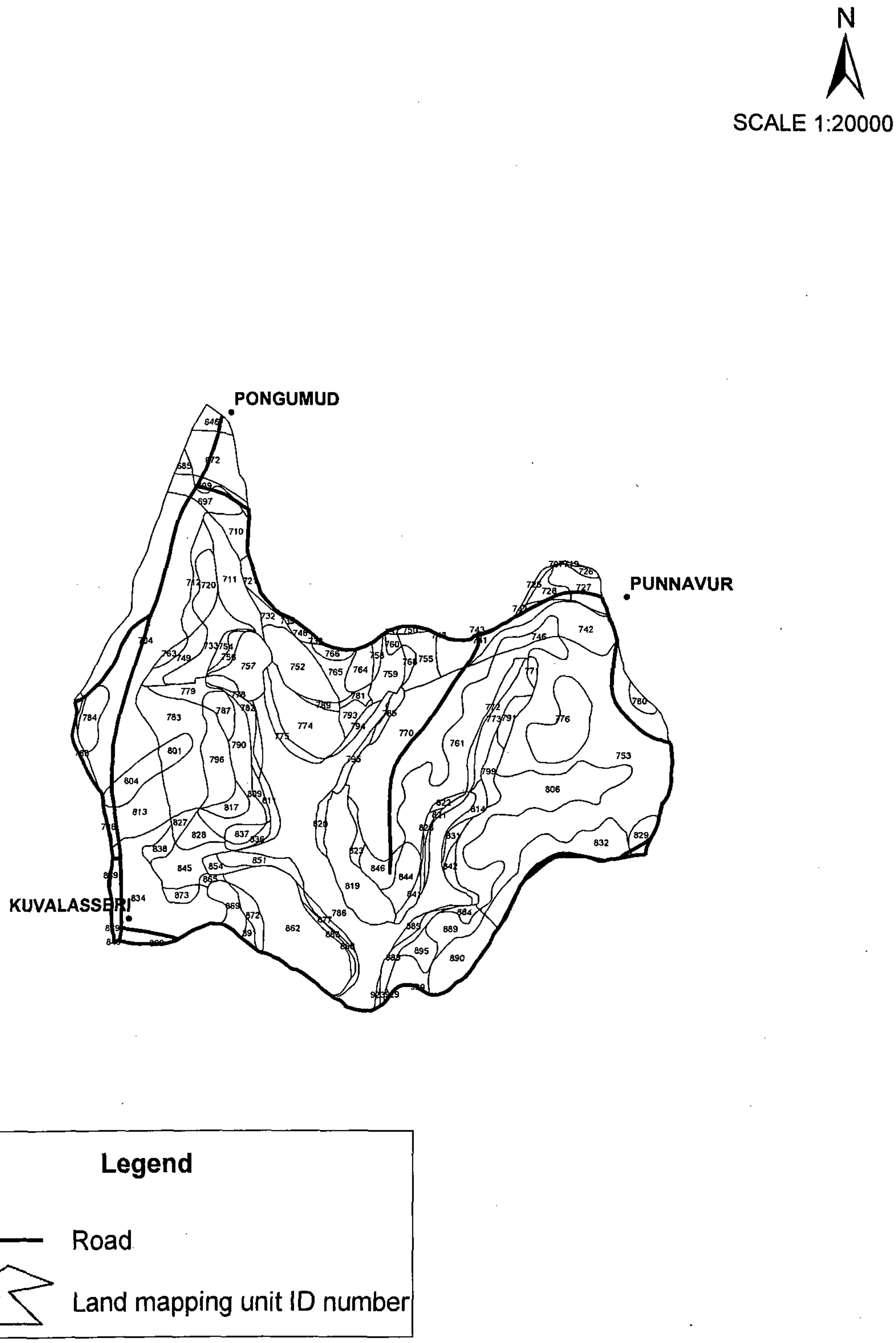

Fig 21.10 Land mapping units of microwatershed 1N6a4 in spatial crop suitability model

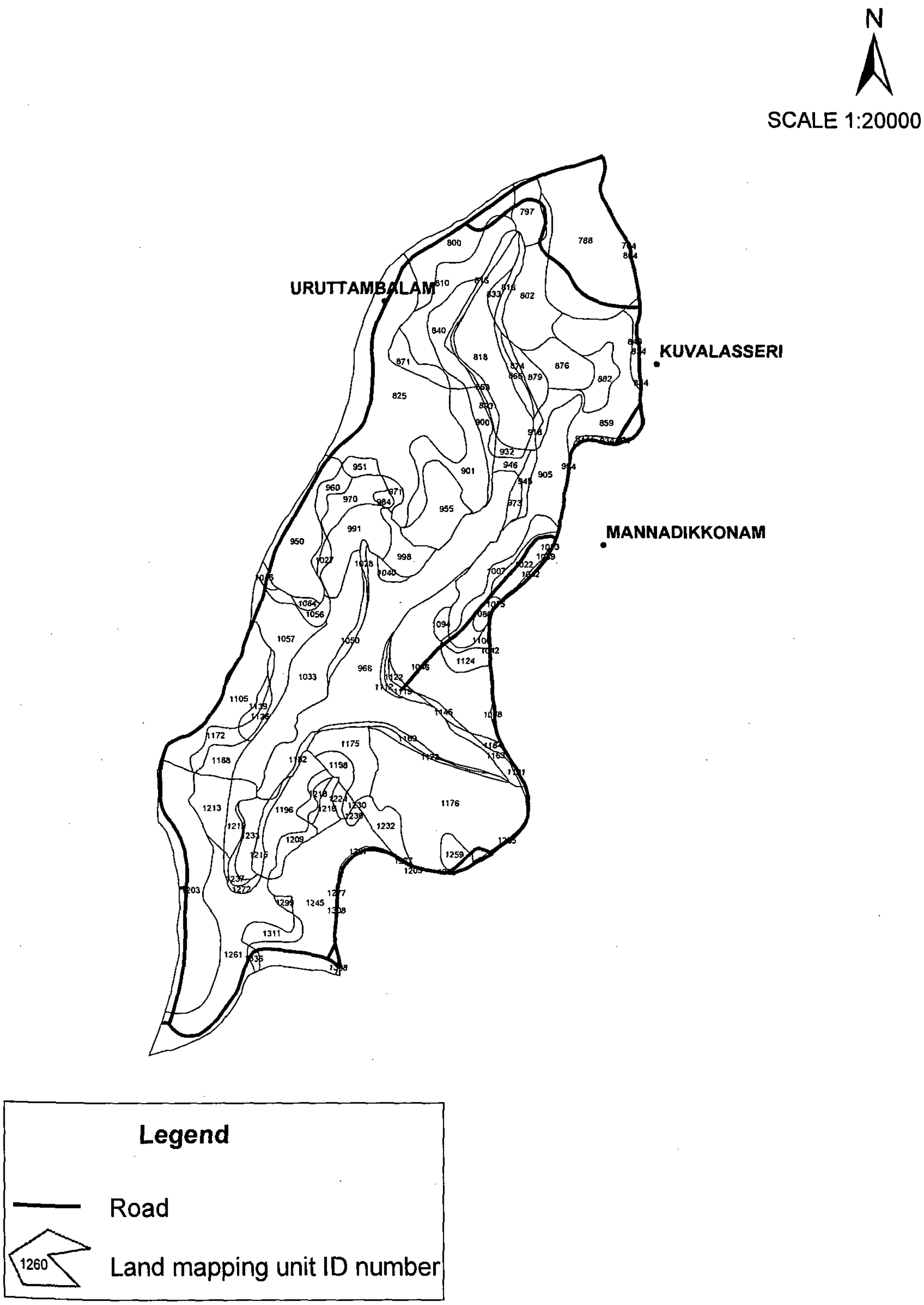

Fig 21.11 Land mapping units of microwatershed 1N6a3 in spatial crop suitability model

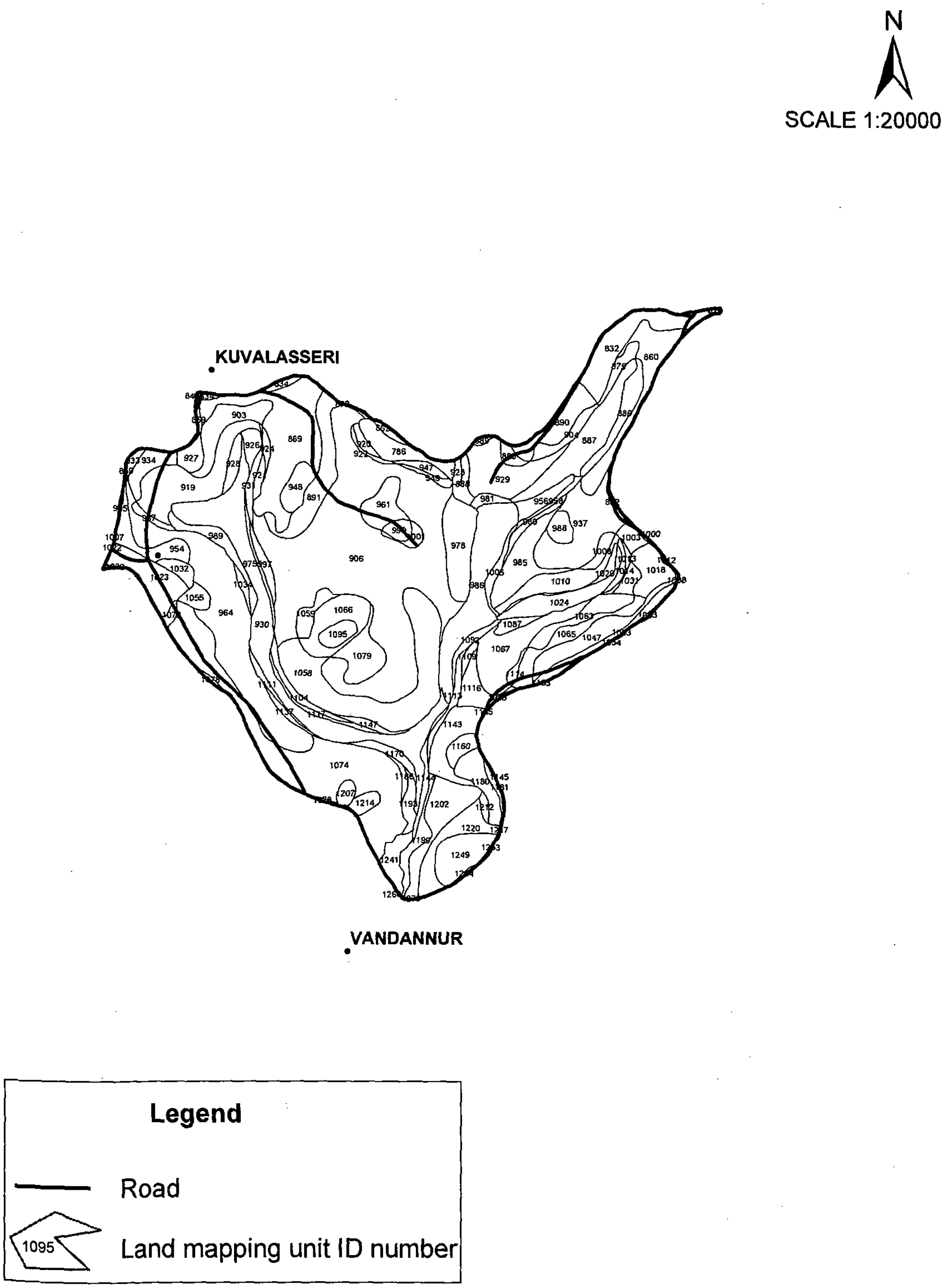

Fig 21.12 Land mapping units of microwatershed 1N6a5 in spatial crop suitability model

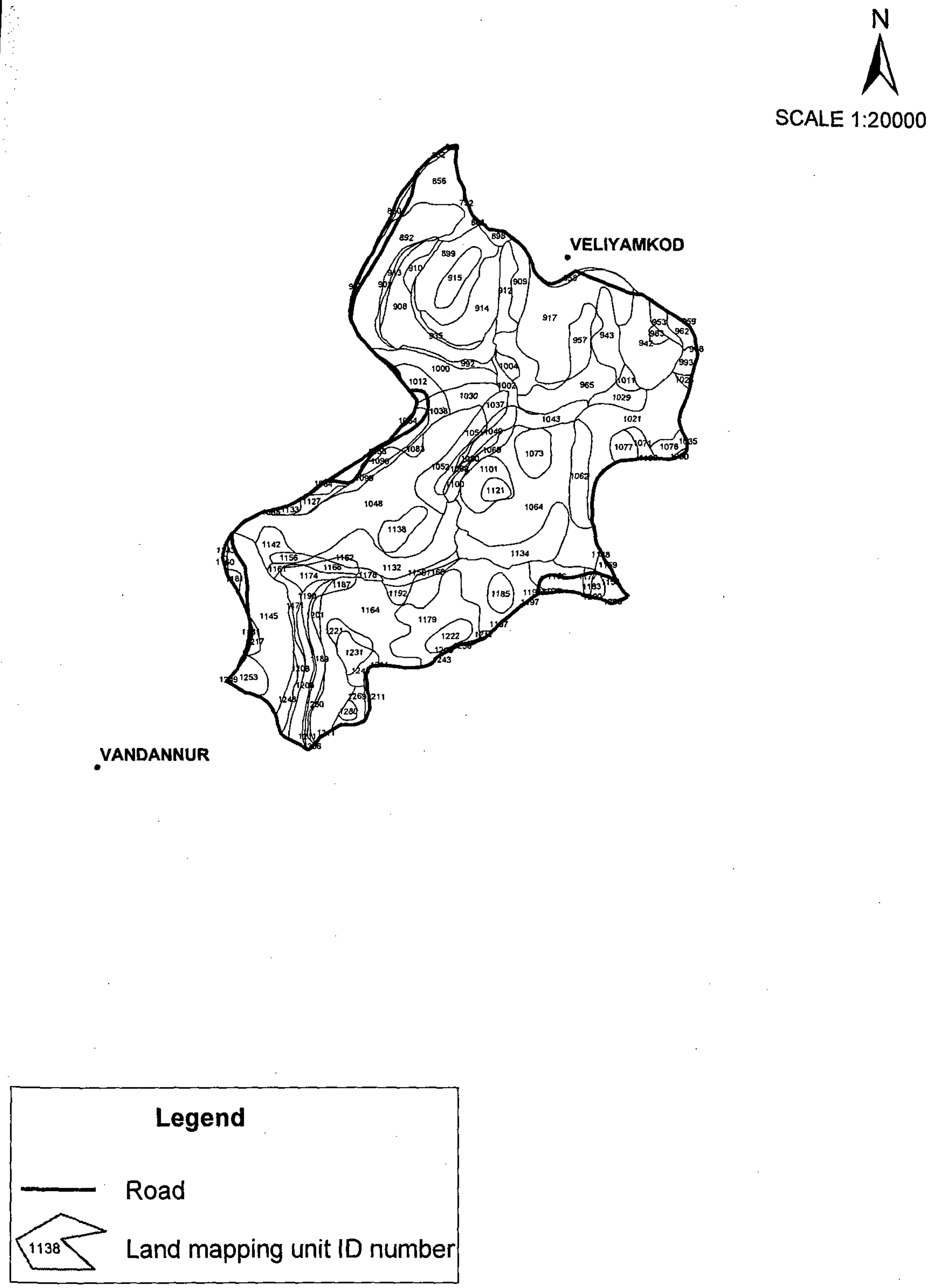

Fig 21.13 Land mapping units of microwatershed 1N6a6
in spatial crop suitability model

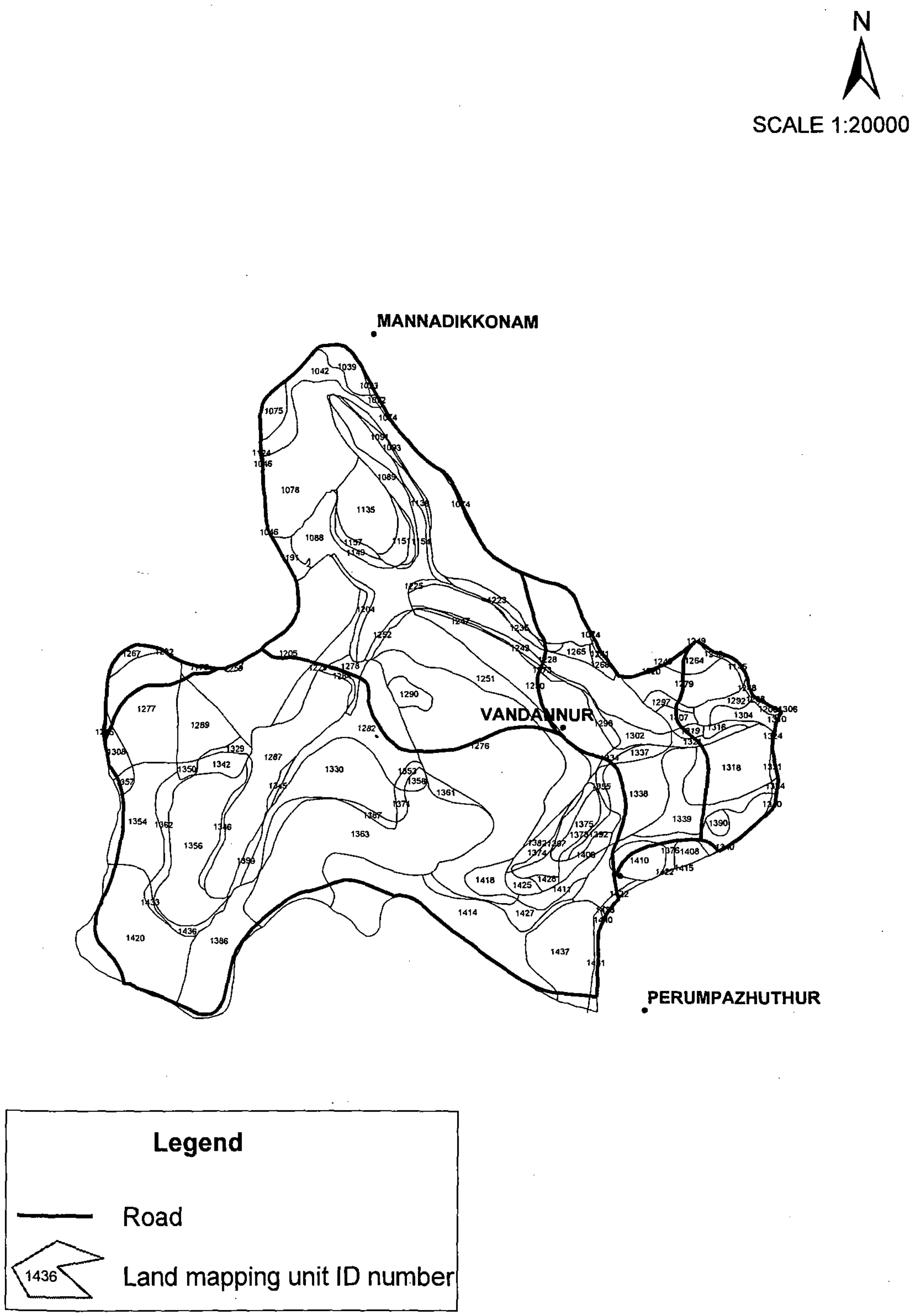

Fig 21.14 Land mapping units of microwatershed 1N6a2 in spatial crop suitability model

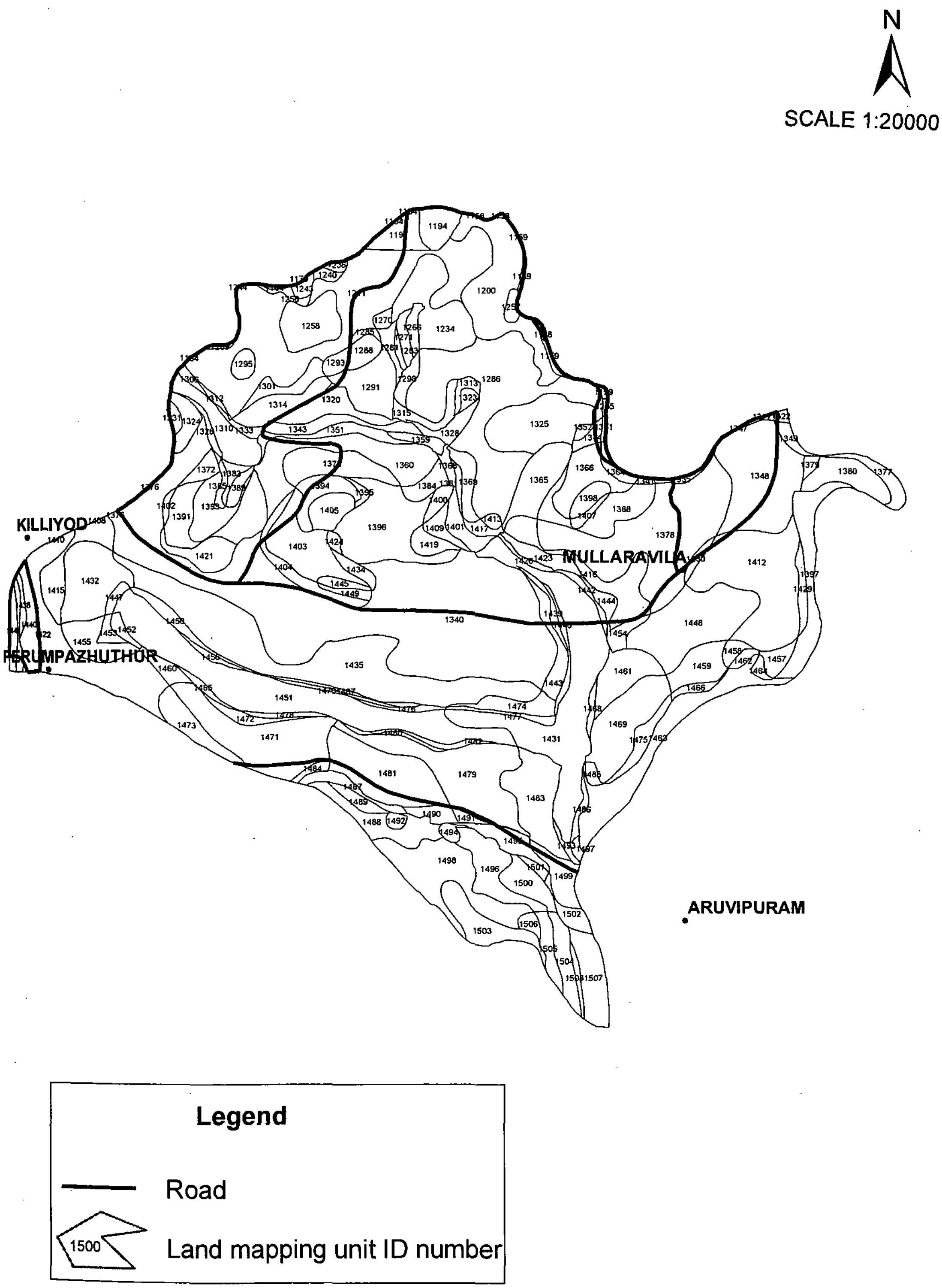

Fig 21.15 Land mapping units of microwatershed 1N6a1 in spatial crop suitability model

In total, there were 1508 Land Mapping Units (LMUs) for the entire study area with area ranging from 0.201 hectares to 37.411 hectares. Similarly there was variation in the biophysical parameters among the LMUs as evident from the spatial crop suitability model. Hence the suitability of each LMU for different crops also showed variation. Using this model the crop suitability of each LMU in the watershed area was arrived at for sustainable agriculture development.

4.7.7.1 Initial crop suitability recommendation

The suitability of LMUs for different crops was attempted at three levels, namely S1, S2 and S3 through evaluation of the biophysical factors of the individual LMU. In this process, the decision was taken through logical matching of the biophysical factors of each LMU with that of the requirements of each crop furnished in Appendix VII. The details of initial crop suitability recommendations thus derived for each LMU are also shown in Table 35. On the basis of this information, the consolidated crop wise initial recommendation for the entire Aruvipuram watershed area was computed and the same is furnished in Table 36.

As revealed by Table 36, under this category the maximum area of the watershed ie., 49.62 per cent could be put under coconut followed by cashew (16.30 %), rubber (13.23 %), paddy (6.56 %) etc. As per the suitability class S2, the maximum area ie., 42.07 was found to be suitable for rubber followed by coconut (22.92 %), banana (6.97 %), vegetables (6.74 %) etc. Nutmeg was found to be suitable for the least area of 2.612 hectares as per the S2 suitability class. As per the suitability class S3, 18.87 per cent of the total watershed area was found to be suitable for rubber, followed by cocoa (15.92 %), tapioca (13.42 %), coconut (12.07 %) etc. From the above results it could be concluded that on the basis of evaluation of biophysical factors, nearly 50 per cent of the selected watershed area is best suited for coconut crop while about 16 per cent and 13 per cent of the area are best suited for cashew and rubber crops, respectively.

Table 36. Consolidated data on initial crop suitability recommendation for Aruvipuram watershed

S1 (Highly Suitable)			S2 (Moderately Suitable)			S3 (Marginally Suitable)		
*Crop	Area (Ha)	%	*Crop	Area (Ha)	%	*Crop	Area (Ha)	%
A	86.456	2.78	A	45.936	1.48	A	22.191	0.72
B	102.523	3.30	B	216.861	6.97	B	266.407	8.57
C	1542.641	49.62	C	712.653	22.92	C	375.138	12.07
G	0.256	0.01	G	6.738	0.22	G	0.586	0.02
H	506.685	16.30	H	141.130	4.54	H	317.700	10.22
I	73.810	2.37	I	74.296	2.39	I	20.466	0.66
M	32.691	1.05	L	85.986	2.77	L	130.353	4.19
P	204.088	6.56	M	109.447	3.52	M	28.853	0.93
R	0.873	0.03	N	2.612	0.08	N	301.408	9.69
T	3.840	0.12	O	102.420	3.29	O	494.956	15.92
U	411.391	13.23	R	15.163	0.49	R	41.925	1.35
V	93.583	3.01	T	48.318	1.55	S	18.305	0.59
W	50.283	1.62	U	1307.999	42.07	T	417.328	13.42
			V	209.543	6.74	U	586.899	18.87
			W	30.018	0.97	V	54.872	1.76
						W	31.733	1.02
	3109.12	100		3109.12	100		3109.12	100

* A - Arecanut
B - Banana
C - Coconut
G - Ginger
H - Cashew
I - Pineapple
L - Clove
M - Mango
N - Nutmeg
O - Cocoa
P - Paddy
R - Pepper
S - Sapota
T - Tapioca
U - Rubber
V - Vegetables
W - Pulses

4.7.7.2 Final crop suitability recommendation

Final crop suitability recommendations for the entire watershed area of 3109.12 hectares was derived by modifying the initial crop suitability recommendations, on the basis of socio-economic land evaluation for crop suitability. Here the crop suitability was finalised after eliminating four crops namely mango, cocoa, pineapple and sapota. The final crop suitability recommendations for individual LMU are also furnished in Table 35. On the basis of this data, the consolidated cropwise final recommendation under each suitability class for the entire watershed area is given as Table 37.

As revealed by Table 37, in the highly suitable category (S1), out of the total watershed area of 3109.12 hectares, 49.91 per cent of the area was best suitable for coconut crop followed by cashew (18.69 %) and rubber (13.75 %). As per the moderately suitable class (S2), 47.35 per cent of the total area was suitable for rubber crop followed by coconut (26.96 %), banana (7.13 %), vegetables (6.74 %) etc. As per the marginally suitable class (S3), it was found that 20.90 per cent of the area was suitable for tapioca crop followed by rubber (18.66 %), cashew (16.11 %), nutmeg (15.44 %) etc.

For achieving sustainable agriculture development in the watershed area, with regard to crop selection, the best option is to follow the recommendations given under S1 class for each LMU and if not the recommendations under S2 class. The least option is to follow the recommendations under S3. Hence it can be concluded from the above data, that out of the total watershed area of 3109.12 hectares nearly 50 per cent of the area was best suited for coconut crop, nearly 19 per cent was best suited for cashew crop and nearly 14 per cent was best suited for rubber crop. In addition 204.088 hectares in the watershed area has to be put under paddy as suggested through integration of biophysical factors.

During the course of investigation, it was found that the trend in converting paddy lands of the watershed area for other uses is increasing.

Table 37. Final crop suitability recommendation for Aruvipuram watershed

S1 (Highly Suitable)			S2 (Moderately Suitable)			S3 (Marginally Suitable)		
*Crop	Area (Ha)	%	*Crop	Area (Ha)	%	*Crop	Area (Ha)	%
A	87.087	2.80	A	45.936	1.48	A	22.191	0.71
B	102.523	3.30	B	221.708	7.13	B	283.162	9.11
C	1551.733	49.91	C	838.571	26.96	C	306.206	9.85
G	0.256	0.01	G	6.738	0.22	G	0.586	0.02
H	580.975	18.69	H	127.067	4.09	H	501.021	16.11
P	204.088	6.56	L	85.986	2.77	L	159.647	5.13
R	0.873	0.03	N	2.612	0.08	N	480.174	15.44
T	3.491	0.11	R	15.163	0.49	R	47.167	1.52
U	427.562	13.75	T	48.667	1.57	T	649.606	20.90
V	93.583	3.01	U	1472.338	47.35	U	580.011	18.66
W	56.949	1.83	V	209.543	6.74	V	54.872	1.76
			W	34.791	1.12	W	24.477	0.79
	3109.12	100		3109.12	100		3109.12	100

* A - Arecanut
B - Banana
C - Coconut
G - Ginger
H - Cashew
R - Pepper
W - Pulses
L - Clove
T - Tapioca
N - Nutmeg
V - Vegetables
P - Paddy
U - Rubber

Presently the area under paddy in the entire watershed is only less than ten hectares. The remaining area which was found to be suitable for paddy are put under other seasonal crops like banana, tapioca and vegetables as they are more remunerative to the farmers presently. It was felt that this trend will ultimately make the watershed area an unsustainable ecosystem resulting in problems such as severe drought, severe floods, shortage of drinking water, change in micro climate, poverty, lack of food security etc. It was also evident that already more than fifty per cent of the earlier existed wet lands were permanently converted for other uses. Hence atleast the lands now suggested for paddy which are presently being put under seasonal crops like banana, tapioca, vegetables etc. have to be reconverted to paddy crop for the sustainable management of the watershed as well as food security.

As evident through the investigation, still now there is very high social acceptability for the paddy crop in the area and the farmers are prepared to take up paddy cultivation in the above area provided efforts are taken up at Government level to make paddy more remunerative. The following are some of the suggestions arrived at through interaction with the farmers of the locality for the purpose.

1. Introducing a system of production based incentive or subsidy for paddy crop.

2. Organising the paddy cultivation in the watershed area through a registered self help group.

3. Timely and sufficient supply of irrigation water and other inputs.

4. Introducing appropriate farm machineries for various field operations.

5. Introducing a stable and effective marketing system in the watershed area for the sale of produce.

6. Providing required road network to paddy fields for using the farm machineries.

7. Establishment of labour bank in the watershed area to supply the required labourers as and when required.

8. Avoiding unhealthy political interferences at all stages of paddy cultivation.

On the basis of land evaluation it was also found that a substantial area was best suited for cashew crop in the watershed area. But it was found that except an area of about 2.50 hectares of a new cashew plantation existing near Pongumoodu area, cashew was not grown as a plantation in the area. Majority of LMUs best suited for cashew are presently cultivated with other crops such as coconut, rubber, tapioca, banana and mixed trees.

The study further revealed that the watershed area is predominantly best suited for a coconut based farming system. The coconut based farming system has the advantage of optimum utilisation of each LMU by putting it under multi-tier cropping system with intercrops of banana, pepper, tapioca, other tubers, spices and fodder along with coconut. Similarly, some of the LMUs suggested for arecanut crop especially along river and stream banks can be used for intercropping with betelvine and vanilla, for which further location specific studies of the LMUs have to be attempted. In the present study further detailed location specific study of the LMUs for intercrops could not be attempted due to various resource and time limitations.

Rubber crop was existing as one of the predominant crops especially towards the eastern side of the watershed area. It was found that some of the existing rubber area may fall under the S2 and S3 suitability classes for rubber crop on the basis of the land evaluation carried out through the present study.

It is also recommended that to make the watershed area an optimally sustainable eco-system, the LMUs must also be protected with appropriate location specific soil and water conservation measures for which seperate field level investigations have to be carried out. This is essential for the sustainable existence of the different crops recommended for the LMUs under this study.

4.7.8 Utility of remote sensing technology for micro level resource evaluation

In the present study, remote sensing technology was used as one of the tools for deriving the primary spatial data on biophysical factors for land evaluation. Black & White aerial photographs on 1:15000 scale and Indian Remote Sensing Satellite images of IRS-1C (LISS III) geocoded false colour composite of February 2000 were the data products used in this study.

It was found that the aerial photographs on 1:15000 scale were highly useful in delineating and codification of micro watersheds, in preparing the primary spatial data base on physiography, soil erosion, ground water potential, presence of rocks/stones/gravels, soil depth and in studying the characteristics of micro watersheds.

The satellite images used were effective only to limited extent in deriving large scale primary spatial database for the purpose of this study due to the limitation of resolution. Hence it was found that IRS data products can presently provide only partial support in generating large scale spatial information for micro watershed level studies under Kerala situation. This was in line with the findings of earlier study carried out in Kerala by Ramachandran and Samsuddin (2002). Hence it can be concluded that for generating large scale spatial data base for micro level planning in situations like Kerala with dense vegetative canopy coverage, high intensity of cropping etc. satellite images of higher resolution, preferably more than one metre is most ideal. It is expected that the future missions of Indian Space programme would cater this requirement.

4.8 PERCEPTION OF FARMERS ON THE UTILITY OF THE SPATIAL CROP SUITABILITY MODEL FOR SUSTAINABLE AGRICULTURE

To study the perception of farmers, the information collected through focus group interviews were subjected to analysis as explained by Kreuger (1988). The procedure involved was in analyzing the trends and patterns reappearing in the focus group interviews. The emphasis comments were also considered. The summary of perception of the farmer respondents on the utility of the spatial crop suitability model for sustainable agriculture development is presented below.

In general, the derived spatial crop suitability model was found to be good from the point of agriculture development. It would serve as a guideline for the farmers as well as planners to decide upon the ideal crops to be grown in each locality. It would help the stakeholders of land use to arrive at right decisions on the land utilization pattern for the area. It will help in eliminating the unsuitable crops for each locality. It would also help as a guide for deriving optimum production from each piece of land at micro level as the minimum size of the LMUs is 0.20 hectares.

The spatial crop suitability model would help in the sustainable management of the watershed area as it highlights the biophysical factors of each LMU. This would help in controlling the land degradation problems. For example, in the study area the trend of paddy field conversion was found to be increasing, which would lead to long lasting land degradation problems. The spatial crop suitability model would help in identifying such type of lands, assessing its problems and potentials and exploring the possibility of its sustainable management.

As perceived by the respondents, regarding the utility of spatial crop suitability model for the activities of Department of Agriculture, it serves as a guide for Krishi Bhavan to identify the best suited crops for each locality which is a must for planning the essential and timely inputs needed by each Krishi Bhavan area from the point of view of agricultural development. This would also help in deciding appropriate storage and marketing facilities required for each region from time to time.

As opined by the farmer-respondents the best aspect of such a crop model is that besides its scientific content, it also takes into consideration the socio-economic aspects of the watershed area through participatory approach for deciding the best suitable crops. This would help the model in acquiring more social acceptability.

The constraints expected by the respondents in the effective implementation of the recommendations of spatial crop suitability model are lack of political will, untimely supply of required inputs, lack of required agro based industries, shortage of irrigation water during peak periods, fluctuations in market prices especially for crops like pepper, arecanut etc, low turn out from agricultural labourers, high labour charges and vanishing landlord - labourer relationship.

SUMMARY AND CONCLUSION

5. SUMMARY

Sustainable development through resource based planning helps productivity enhancement as well as environment conservation. Often this is ignored for short term and immediate benefits by mankind. Sustainable resource management especially at micro level needs spatial planning with the use of maps supported by relevant data. This provides valuable information for location specific spatial planning for sustainable development.

Spatial planning in the context of sustainable agriculture development can be achieved by the process of 'land evaluation'. Land evaluation in agriculture sector can be best envisaged through 'agro-ecological zoning' and 'watershed approach'. The concept of integrated approach of land evaluation for crop suitability was introduced by FAO since mid seventies and updated periodically. To obtain practical and optimum use from such an evaluation, besides biophysical factors socio-economic factors also needs due consideration. This is termed as integrated land evaluation. The technology of remote sensing provide realistic and timely spatial data of biophysical factors and hence can provide unique support for such an evaluation.

Land evaluation for sustainable agriculture development with many advantages succeed only with proper user response. Hence assessing the user response was also important. The store house of knowledge at the local level is a power tool for the sustainable management of the land resources. This gave birth to the concept of Participatory Appraisal of Natural Resources (PANR), a way to learn from the local community about the natural resources and related issues. Similarly, as the conative response of the users cannot be studied easily, their perceived opinion will give the likely utility.

In the above context the present study was undertaken through the process of participatory and integrated land evaluation for sustainable agriculture development. The specific objectives of the study were :

1. To identify the most important biophysical and socio-economic factors to be considered in participatory and integrated land evaluation for crop suitability aimed at sustainable agriculture development.

2. To measure the awareness of Agricultural Officers on land evaluation for sustainable agriculture development.

3. To measure the knowledge level of Agricultural Officers on land evaluation for sustainable agriculture development.

4. To measure the attitude of Agricultural Officers towards land evaluation for crop suitability.

5. To study the relationship of selected profile characteristics of Agricultural Officers with their awareness, knowledge and attitude towards land evaluation for sustainable agriculture development.

6. To develop 'spatial crop suitability model' through participatory and integrated land evaluation at micro watershed level in a selected area.

7. To access the likely utility of the spatial crop suitability model as perceived by the farmers of the study area.

The limitation of time, infrastructure, finance etc. forced the researcher to limit the study area with in Thiruvananthapuram district of Kerala state. The first objective was envisaged through ranking of selected eighty biophysical and socio-economic factors by forty judges using the Pusa rank sheet for Q-sort. For the second to fifth objectives, the respondents consisted of all the Agricultural Officers working in Thiruvananthapuram district. The sixth objective was fulfilled by selecting a representative watershed area of 3109.12 hectares from the major watershed of Neyyar in Thiruvananthapuram district. This selected watershed area was named as 'Aruvipuram watershed'. The primary spatial database (maps) of the selected area on biophysical factors were generated with the help of secondary non-spatial / spatial database, remote sensing data products (aerial photos and satellite images), Survey of India topomaps and ground truth. The primary spatial database was evaluated and confirmed through the process of participatory approach using the method of PANR. Besides, thirty progressive farmers of the study area were randomly selected as respondents for the participatory land evaluation of selected socio-economic factors.

The spatial database of biophysical factors were integrated using GIS (ARC/INFO package) to generate the integrated polygons for the study area termed as 'Land Mapping Units' (LMUs). The spatial data (map) along with the tabular information generated through GIS on 1:10,000 scale was termed as the 'spatial crop suitability model'. Using this spatial crop suitability model, crop suitability recommendations for the watershed area at S1, S2 and S3 levels (highly suitable, moderately suitable and marginally suitable respectively) were generated in line wih the 'factor rating' method of FAO in terms of yield. The thirty respondents of socio-economic land evaluation formed the respondents for the seventh objective also. This was fulfilled through focus group interviews of the respondents.

The dependent variables of the study were awareness, knowledge and attitude of Agricultural Officers towards land evaluation for sustainable agriculture. Awareness of Agricultural Officers on land evaluation was measured using a 'teacher made test' of 15 items developed for the study. Knowledge of Agricultural Officers on land evaluation was measured using a knowledge test of 13 items developed for the study and attitude of Agricultural Officers towards land evaluation for crop suitability was measured using a scale of 15 items developed for the study.

The seventeen selected independent variables were the profile characteristics of Agricultural Officers. They were sex, age, educational status, rural/urban background, training received, job experience, cosmopoliteness, exposure to internet/information technology, entrepreneurial behaviour, innovation proness, self confidence, scientific orientation, achievement motivation, attitude towards profession, job satisfaction, job involvement and organisational climate. These variables were measured using the available measuring instruments wherever possible or with the instruments developed for the purpose of this study as per requirement.

The rating of biophysical and socio-economic factors by the selected judges was carried out using Pusa rank sheet for Q-sort through mail or in person. Structured mail questionnaire were used to collect the response of Agricultural Officers. Participatory approach in land evaluation for socio-economic factors were carried out using a proforma through interview. The focus group interviews of the respondents were done with the help of an unstructured, open-ended questionnaire. The statistical tools used in the study were mean, standard deviation, percentage analysis and correlation analysis.

The salient findings of the study are presented below.

1. Nineteen factors consisting of both biophysical and socio-economic factors were identified as the most important or critical factors of land evaluation for sustainable agriculture development.

2. The thirteen biophysical factors identified were slope, rainfall, physiography, soil depth, soil texture, soil drainage, soil erosion, temperature, elevation, presence of rocks / gravels / stones, soil pH, ground water and major nutrients.

3. The six socio-economic factors identified were economic viability, economic feasibility, infrastructural facilities, market demand, social acceptability and farming experience.

4. The respondents, namely Agricultural Officers, consisted of 55 per cent male and 45 per cent female.

5. With respect to profile characteristics, namely age, educational status, training received, exposure to Internet / IT and achievement motivation, the per cent of low group respondents was more.

6. With respect to profile characteristics such as rural/urban background, cosmopoliteness, entrepreneurial behaviour, innovation proness, self confidence, attitude towards profession, job satisfaction, job involvement and organizational climate, the maximum per cent of respondents was in high group category.

7. Profile characteristics namely job experience and scientific orientation had equal number of respondents in both low and high groups.

8. Majority of the Agricultural Officers were in the medium category with respect to their awareness and knowledge on land evaluation for sustainable agriculture development.

9. Majority of Agricultural Officers had favourable attitude towards land evaluation for crop suitability.

10. The independent variable, namely job involvement had positive significant relationship with the dependent variable awareness.

11. The independent variables attitude towards profession had a significant positive relationship and the variables namely age, rural/urban background, training received, job experience had a negative and significant relationship with the dependent variable knowledge.

12. Seven independent variables namely educational status, exposure to Internet/IT, entrepreneurial behaviour, self confidence, scientific orientation, attitude towards profession, job involvement had significant and positive relationship and the variable rural/urban background had a negative and significant relationship with the dependent variable attitude.

13. There existed significant and positive relationship among the three dependent variables.

14. The Aruvipuram watershed covered four agro-ecological situations namely Mid land wet condition (MLW), Midland dry condition (MLD), Midland dry situation - red loam soil (RLS) and Homestead farming situation (HF). Out of this, major portion (40.26 %) was occupied by HF.

15. The study area was delineated and codified into fifteen micro watersheds. The code numbers ranged from 1N6a1 to 1N6a6 and 1N7a1 to 1N7a9.

16. The area of micro watersheds ranged from 76.07 hectares to 361.04 hectares. The shape of the micro watersheds varied from square to feather. The dominant crops were coconut, banana, tapioca and rubber. The erosion status was moderate to severe. The drainage pattern was rectangular and dentritic.

17. The major slope category of the watershed area was 15 to 35 per cent and the major physiography unit was side slope.

18. The watershed had predominantly moderately deep to deep soils and the predominant soil texture was gravelly clay loam. Also the soils were predominantly well drained.

19. The erosion status of the area was mainly moderate with majority of the area having surface soil stoniness of 15 to 40 per cent.

20. The predominant elevation of the area was 50 to 80 meters above MSL and the watershed area possessed predominantly moderate ground water potential.

21. The predominant soil pH of the study area was between 6.1 to 6.5. The major nutrient status of the soil were medium to low.

22. It was found that the area was suitable for growing a wide range of both seasonal and perennial humid tropical crops with predominance to coconut based farming system.

23. Participatory socio-economic land evaluation revealed that four crops namely pineapple, mango, sapota and cocoa were not suitable for the area due to various reasons.

24. Integrated land evaluation on 1:10000 scale with the support of GIS (ARC/INFO), yielded 1508 'Land Mapping Units' (LMUs) with varying characteristics in terms of biophysical factors. The spatial distribution of LMUs with tabular data was termed as the 'crop suitability model' for the purpose of this study.

25. Inline with the FAO crop suitability rating of biophysical factors, it was found that under S1 suitability the maximum area in the watershed can be put under coconut crop. Similarly under S2 and S3 the suitability was rubber crop.

26. After modifying the crop suitability rating on the basis of socio-economic land evaluation, the maximum area suited under S1, S2 and S3 suitability classes were coconut, rubber and tapioca crops respectively.

27. In respect to the utility of remote sensing technology, it was found that 1:15000 Black & White aerial photographs were highly useful for micro watershed level studies. But the IRS-1C (LISS III) satellite images were effective only to limited extent for micro

watershed level studies under Kerala situation due to the limitation of its resolution.

28. As expressed by the farmers in focus group interview, the utility of the spatial crop suitability model is found to be good.

29. As opined by farmers the best part of the spatial crop suitability model is that besides its scientific element it has also taken into consideration the socio-economic situation of the area through participatory approach.

30. As perceived by the farmers there will be utility of the spatial crop suitability model for planners, officers of Department of Agriculture and farmers. It will help them in decision making and for the timely distribution of location specific inputs for agriculture development.

31. The major constraints anticipated in the practical utility of the spatial crop suitability model as perceived by farmers are lack of political will, high labour cost, vanishing landlord-labour relationship, fluctuation in market prices etc.

5.1 PRACTICAL / SCIENTIFIC UTILITY

The practical / scientific utility of the present study is substantial. The methodology for crop suitability model developed through participatory and integrated approach in this study will serve as a guideline in deriving similar models for other parts of the State. The model has good practical utility as it is evolved based on in depth studies of diversified agro-ecological situation and also taking into consideration the socio-economic factors of the area related to agriculture development. Here emphasis was given for the conservation development and management of the land resources through resource based planning which is very essential for sustainable agriculture. Hence the crop suitability model will help in sustainable agriculture development.

Similarly, the measurement devices developed for the study would be an addition to the body of research in agricultural extension.

5.2 SUGGESTIONS FOR FUTURE RESEARCH AND DEVELOPMENT

1. Following the procedure employed in deriving the spatial crop suitability model for this study, the Department of Agriculture in collaboration with line departments and Kerala Agricultural University can take up a major project for deriving location specific crop suitabilities at micro watershed level for the entire State.

2. The database generated through the above mentioned project can be fully utilised in the KISSAN project presently launched by the Department of Agriculture, Government of Kerala.

3. The HRD division of the Department of Agriculture must be strengthened with emphasis on the various aspects of land evaluation in the context of sustainable agriculture development. This will equip the officers of Department of Agriculture to undertake systematic land evaluation for crop selection and management aimed at sustainable agriculture development.

4. Appropriate location specific studies must be under taken by Kerala Agricultural University for different crops at the appropriate NARP research centres to finalise the crop suitability standards for the biophysical factors at micro level. This will also help KAU in providing location specific recommendations for the different crops in the 'Package of Practices'.

REFERENCES

REFERENCES

Abrol, I.P. 1994. Nature and extent of soil degradation problems in India. *Indian Fmg.* 44(9) : 7-10

Agnihotri, Y. and Samra, J.S. 1998. Watershed management - A key to uplift socio economic status in Shivalik foot hill villages of India. *J. Soil Water Cons.* 42 : 176-182

*Ahmadu, A. 1988. Land evaluation for irrigation. Ph.D. thesis, University of Great Britain, Ireland, p.67

Allport, G.W. 1935. Attitudes. *A Hand book of Social Psychology.* (ed. Murchison, C.). Clark University Press, Worcester, pp. 789-844

Anandkumar, S. and Nandini, N. 2002. Participatory learning, experimentation and extension perspectives. *Kisan Wld.* 29(7): 25-26

Anantharaman, M. 1991. Management efficiency of cassava farmers. Ph.D. thesis, Kerala Agricultural University, Thrissur, p. 106-114

Anithakumari, P. 1989. Transfer of technology on pulses and oilseed cultivation in Onattukara tract of Kerala. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 85

Ashaletha, S. 2000. Impact of NARP on agriculture development in Southern Agro-climatic zone of Kerala. Ph.D. thesis, Kerala Agricultural University, Thrissur, p. 14, 88-89, 149-155, 191-192

*Baars, R.M.T. 1996. *Conditions and Management of Range lands in the Western Province of Zambia*. Technical Report 1996. Wageningen Agricultural University, p. 152

Babu, A.R. and Singh, Y.P. 1984. Pusa rank sheet for Q-sort technique. *Indian J. Ext. Edn.* 20 : 52-57

Babu, M.N. 1995. Evaluation perception of homestead farmers in relation to appropriateness of farming systems and cropping pattern. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 123

Babu, S.R.A. 1980. A study on the functioning of integrated dry land agricultural development project. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore, p. 73

Balasubramani, V. 1981. Farmer's service co-operative society - A participative analysis, M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore, p. 79-80

Balu, S.R.A. 1980. A study on the functioning of integrated dry land agricultural development project. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore, p, 40-60

Basha, M.J.A.W., Menon, K.R. and Chandrakandan, K. 1975. A study on the attitude of Deputy agricultural officers towards adaptive research programme. *Madras Agric. J.* 62 : 799-803

Bava, N. 1997. *Non-governmental organizations in Development : Theory and Practice.* Kanishka Publishers, New Delhi, p. 288

Beck, K.J. 1981. From soil survey interpretation to land evaluation. Part I. From the past to the present. *Soil Survey and Land evaluation* 1(1) : 6-12

Beena, S. 2002. Performance and potential of gramasabhas in crop production in Athiyanoor Block in Thiruvananthapuram district, M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 74

Beena, S. 2002. Performance and potentials of Gramasabhas in crop production in Athiyanoor block of Thiruvananthapuram district. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 60-61

Behera, C. and Sahoo, M.S. 1975. Impact of national demonstration on adoption of agricultural practices. *Indian J. Ext. Edn.* 11 : 32-35

Bhardwaj, S.P. and Dhyani, B.L. 1994. Achievements and prospects of operational research projects on integrated watershed management in India. *Indian J. Soil Cons.* 22 : 251-262

*Bhatia, K. and Rajendran, D. 1996. A study of some factors affecting the adoption of poultry farming in Hissar district, Punjab. *Summaries of Extension Research by Post Graduate Students.* Punjab Agricultural University, Ludhiana, p. 50-58

Bhatnagar, S. and Singhal, A. 1984. Attitude of women participants towards integrated child development services (ICDS). *Indian J. Ext. Edn.* 20 : 67-68

Bhuyan, B. 2000. An economic analysis of watershed management project. *J. Soil Water Cons.* 44 : 171-178

Blair, J. 1978. *Introduction to Behavioural Science for Business*. Wiley Eastern Ltd., New Delhi, p. 789-844

Bonny, P.B. 1991. Adoption of improved agricultural practices by commercial vegetable growers of Ollukara block in Thrissur district. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 172

Bora, P.C. 1991. Low yields in NE Region. *The Hindu Survey of Indian Agriculture 1991* (ed. Ravi, N.). The Hindu, Madras, p. 20-23

Buringh, P. 1989. Availability of agricultural land for crop and livestock population. *Food and Natural Resources* (eds. Pimental, D. and Hall, C.W.). Academic Press, San Diego, pp. 69-83

*Calvo, R., Blazquez, R. and Macias, F. 1987. Land evaluation in a mountainous area of Golicia (North West Spain). *Areles de Edafologia Y. Agrobiologia* 46 : 897-908

Chandrakandan, K. and Knight, A.J. 1987. A scale to measure attitude of farmers towards farm broadcast. *Indian J. Ext. Edn.* 23 : 71-73

Charjan, Y.D. and Hajare, T.N. 2002. Ecological agriculture solves the problems of Indian agriculture. *Kisan Wld.* 29(7) : 43-45

Chauhan, K.N.K., Singh, R.N. and Singh, M.P. 1990. Impact of training on knowledge of improved agricultural practices of arid zone. *Indian J. Ext. Edn.* 26 : 64-66

Cherian, A. and Chandra, A. 1989. Impact of television on acquisition and retention of knowledge by rural people. *Indian J. Ext. Edn.* 25 : 28-32

Cheriyan, K.B. 1984. Awareness and attitude of farmers, agricultural extension workers and officials towards T and V systems, M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 42, 85-90

Chinene, V.R.N. and Shitumbanuma, V. 1988. Land evaluation of the proposed Musaba farm in Samfya district, Zambia. *Soil Survey and Land Evaluation.* 8 : 176-182

Chowdhry, K.M. and Gilbert, H.E. 1996. *Reforming Agricultural Extension in Bangladesh : Blending Gender Participation and Sustainability with Institutional Strengthening.* Agricultural Research and Extension Network paper 61. ODI, London, p. 61

Clifford, T.M. and Richard, A.K. 1971. *Introduction to Psychology.* Tata Mc Graw Hill Publication Company, Bombay, p. 509-544

Crow, L.D. and Crow, A. 1956. *Understanding our Behaviour.* Alfred Kompt, New Delhi, p. 23-28

Curran, J.P. 1985. *Principles of Remote Sensing.* Longman Group Limited, London, p.1

Dahama, O.P. 1976. *Extension and Rural Welfare.* Ramprasad and Sons, Agra. p. 421

Dakhore, K.M. and Bhilengaonker, M.G. 1987. Levels of job satisfaction of Veterinary extension personnel. *Indian J. Ext. Edn.* 23 : 65-67

Das, P.K. and Sharma, J.K. 1998. Impact of training on knowledge and perception of rural youth about scientific bee keeping. *J. Ext. Edn.* 9 : 1957-1962

De, Dipak. 1986. Factors affecting entrepreneur characteristics of farmers. *Indian Journal of Social Work.* 46 : 541-546

*De, Mers, M.N. 1989. The importance of site assessment in land use planning, a re-examination SCS LESA model. *Appl. Geogr.* 9 : 287-303

Dent, D. and Young, A. 1981. *Soil Survey and Land Evaluation.* George Allen and Unwin Ltd., London p. 115, 119-121, 128-129, 140,141

Desai, N.K. 1961. Problems of mixed farming. A study of character farm. *Indian J. Agric. Econ.* 16 : 46-50

Devi, R.P. 2003. Micro credit and technology utilisation in vegetable production by self help groups in Thiruvananthapuram district. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur p. 64.

Dhandar, D.G. and Subramanian, S. 1991. Region with high prospects. *Survey of Indian Agriculture 1991* (ed. Ravi, N.). The Hindu, Madras, p. 40-43

Dhar, T.N. 1996. Land use planning in the hill region and people's participation. *The Administrator* 41 : 69-93

Dhruva, V.V.N. and Babu, R. 1983. Estimation of soil erosion in India. *J. of Irrig and Drain Engg.* 109 : 419-434

Diwate, S.A., Bhosale, S.S., Talathi, J.M. and Patil, H.K. 2002. Impact of watershed development activities on beneficiary farm. *Indian J. Soil Cons.* 30 : 87-94

*Durand, D. 1975. Effects of achievement motivation and skills training in the entrepreneurial behaviour of black businessmen. *Organizational Behaviour and Human Performance.* 14 : 76-90

Edwards, A.L. 1957. *Techniques of attitude scale construction.* Vakils, Feffer and Simons, Pvt. Ltd. Mumbai, p. 13, 149-169

Elangovan, R. and Vasanthakumar, J. 1997. Perception of extension officials towards eco-friendly technologies. *J. Ext. Edn.* 8 : 1755-1758

FAO. 1976. *A Frame Work for Land Evaluation.* Soils Bulletin No. 32. FAO, Rome, p. 72

FAO. 1983. *Guidelines : Land Evaluation for Rainfed Agriculture.* Soils Bulletin No. 52. FAO, Rome, p. 1-7, 58-61

FAO. 1987. *Seventh Meeting of the East and South African Sub-committee for Soil Correlation and Evaluation.* FAO World Soil Resources Report. FAO, Rome, p. 161

*FAO. 1989. *Sustainable Agriculture Production Implications for International Research.* Report of the Technical Advisory Committee, Consultative Group on International Agricultural Research, Rome, p. 131

Fathimabi, P.K. 1993. Welfare schemes for agricultural labourers - A multi dimensional analysis, M.Sc. (Ag.) thesis, Kerala Agricultural University, p. 55, 61, 85-90

Ganesan, R. and Muthaiah, M. 1991. Awareness level of agricultural development schemes. *Indian J. Ext. Edn.* 27 : 102-105

Gangadharan, K.K. 1993. Adoption of improved agricultural practices by pepper growers of Idukki district, M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 86-96

Ghosh, B.K., Mahaptra, P.K. and Mahapatra, G. 2000. Impact of watershed management on water and moisture regime - A case study on Nachuninala and Pilasalki watersheds (Orissa). *J. Soil Water Cons.* 44 : 84-87

Ghosh, S. 2002. Farmer's knowledge and GIS. *Kisan Wld.* 29(4) : 31-32

Gichuki, F.N. and Liniger, H. 2000. Participatory development of natural resources management decision support information system for maize. *Proceedings of a Workshop on Deepening the Basis of Rural Resources Management, February 16-18, 2000* (eds. Guijt, I., Berdegue, J.A., Loevinsohn, M. and Hall, F.). ISNAR and RIMISP, Hague, pp. 138-152

Gnanadeepa, A. 1991. Techno cultural profile of rice farmers. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore, p. 117

Government of India. 1997. *Guideline for Watershed Development*. Ministry of Rural Areas and Employment, Department of Wasteland Development, New Delhi : 1-51

Gupta, C.L. and Sohai, T.S. 1976. A scale to measure dairy farmer's attitude towards dairy farming. *Indiian J. Ext. Edn.* 12 : 76-78

Haantjens, H.A. 1965. Practical aspects of land system surveys in New Guinea. *J. Trop. Geogr.* 21 : 12-20

Hanumanikar, R.H., Sundaraswamy, B. and Ansari, M.R. 1997. Socio-economic characteristics of sunflower cultivation in Karnataka. *J. Ext. Edn.* 8 : 1790-1791

Haraprasad, D. 1982. Study on the impact of agricultural programmes implemented by Small Farmers Development Agency among farmers of Trivandrum district. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 59-65

Heggade, O.D. 1982. Women's participation in co-operatives. *The co-operator* 20 : 369-371

Hemalatha, S. 1997. Gender analysis of rice farmers in Thiruvananthapuram district, M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 180

*Holder, C.A. 1984. Principal leadership behaviour and teachers job satisfaction in public elementary schools in Colombo. *Dissertation Abstract International*. ISSN. 45 : 4019-4209

*Jaiswal, N.K. 1965. A study of factors associated with low level of adoption of improved agricultural practices. Ph.D. thesis, Division of Agricultural Extension, IARI, New Delhi, p. 87-96

Jaiswal, N.K. and Purandare. 1982. Planning and management of watersheds in Sholapur district. *J. Rural Develp.* 1 : 688-689

*Jaiswal, N.K. and Roy, N.K. 1968. Farmer's perception of the characteristics of agricultural innovations in relation to adoption. *Proc. Res. Foundn.* 10 : 75-86

Jaiswal, N.K., Purandare, A.P. and Jaiswal, A.K. 1985. Peoples participation in watershed management - a case study of Damodhar Valley Corposation. *J. Rural Develp.* 4 : 409-465

Jayakumar, S., Arockiasamy, D.I. and Britto, S.J. 2002. Conserving forests in the Eastern Ghats through remote sensing and GIS - A case study in Kolli hills. *Curr. Sci.* 82 : 1259-1267

Jayalekshmi, G. 1996. Entrepreneurial behaviour of rural women in Thiruvananthapuram district. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 81

Jayasree, K. and Prasad, R.M. 1994. Analysis of the dimensions of sustainable agriculture. *J. Ext. Edn.* 5 : 822-826

Jayasubramanian, B. 1996. Impact of distance education programme of Tamil Nadu Agricultural University through correspondence course - A diagnostic analysis. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore, p. 80-83

Jayavelu, N. 1980. An analysis of factors responsible for the participation and non-participation of cotton growers in regulated market. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore, p. 73

Jha, P.N. 1968. A critical analysis of factors associated with communication fidelity with reference to high yielding varieties programme. Ph.D. thesis, Division of Agricultural Extension, IARI., New Delhi, p. 95-109

Jnanadevan, R. 1993. An analysis of selected development programmes for promoting coconut production in Kerala. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 120-130

Johnson, A.K., and Cramb, R.A. 1996. Integrated land evaluation to generate risk efficient land use options in a coastal catchment. *Agricultural Systems.* 50 : 287-305

Johnson, A.K., Cramb, R.A. and Mc Alpine, J.R. 1994. Integrated land evaluation as an aid to land use planning in Northern Australia. *J. Environment Management.* 40 : 139-154

Jose, R.A. 1998. Promotional strategy for the utilization of plant based pesticides in vegetable cultivation in Thrissur district - An experimental study, M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 192

Judd, C.M., Drake, R.A. and Downing, J.W. 1991. Some dynamic properties of attitude structures. Context induced response facilities and polarizaton. *J. Personality Soc. Psychol.* 60 : 193-202

Juliana, C.S., Annamalai, R. and Somasundaram, S. 1991. Adoption of integrated pest management practices. *Indian J. Ext. Edn.* 27 : 23-27

Kalavathy, S. 1989. Job satisfaction of agricultural graduates engaged in selected avenues of employment in Alleppey district. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 74, 84-85

Kaleel, F.M.H. 1993. Leadership styles in research management. Ph.D. thesis, Division of Agricultural Extension, IARI, New Delhi, p. 29-35

Kamarudeen, M. 1981. A study on the impact of National demonstration programme on paddy cultivation in Thrissur district. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 228-232

*Kanter, R.M. 1968. Commitment and social organization - A study of commitment mechanism in utopian communities. *American Soc. Rev.* 33 : 499-517

Kar, G. 2001. Remote sensing and GIS technologies for land use planning - A case study in Yacharam watershed, Andhra Pradesh. *Indian J. Soil Cons.* 29 : 77-81

Kar, G. 2001. Remote sensing for sustainable watershed management. *Kurukshetra* 49(6) : 22-23

Kar, G., Reddy, G.P. and Kannan, K. 2002. PRA for natural resources management and research prioritization to improve productivity of rainfed upland ecosysetm. *J. Ext. Edn.* 13 : 3241-3248

Karami, E. 1981. Determinants of job satisfaction among the agricultural extension agents of Iran. *Indian J. Ext. Edn.* 17 : 42-47

Kareem, A.K. and Jayaramaiah, K.M. 1998. Participation of beneficiaries in Integrated rural develoment programmes. *Madras agric. J.* 85 : 20-23

Karim, A.S.M.Z. and Mahboob, S.G. 1992. Factors of job performance of Subject Matter Officers. *Indian J. Ext. Edn.* 28 : 8-14

*Katz, D. and Scotland, E. 1959. A preliminary statement to a theory of attitude structure and change. *Psychology - A study of a Science* (ed. Koch, S.). Mc Graw Hill Book, New York, pp. 221-251

Kavitha, S. 2001. Integrated water management - An expost facto study on differential knowledge and adoption behaviour of rice growers. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore. *P.G. thesis Abstract* 1: 78-79

Kerala State Soil Survey Organisation. 1997. *Soil Survey of Athiyannur Panchayat*. Report No. 213. Department of Agriculture (S.C. Unit), Kerala, Trivandrum, p. 74

Kerala State Soil Survey Organisation. 1997. *Soil Survey of Kodur Panchayat*. Report No. 215. Department of Agriculture (S.C. unit), Kerala, Trivandrum, p. 57

Kerala Agricultural University. 2003. *Package of Practices Recommendations : Crops* (eds. Jose, A.I., Paulose, S., Prameela, P., Bonny, B.P.). Directorate of Extension, Kerala Agricultural University, Thrissur, pp. 49, 63, 71, 103, 108, 177, 180, 184.

Kerala State Land Use Board and National Remote Sensing Agency. 1994. *Integrated Study for Sustainable Development of Attappady Block, Palakkad District, Kerala.* Technical Report. Kerala State Land Use Board, Trivandrum, p. 47-50

Kerala State Land Use Board. 1996. *Watershed Atlas - Neyyar River, Kerala State.* Kerala State Land Use Board, Thiruvananthapuram, p. 1-5

Kerala State Land Use Board. 1997. *Land Resource Based Perspective Plan 2020 AD (A First Approximation).* Kerala State Land Use Board, Thiruvananthapuram, p. 1181, 1192, 1194-1195, 1197, 1200, 1202-1207, 1210, 1216, 1218-1220, 1224-1226

Kerala State Land Use Board. 1999. *Report on Soils of Thiruvananthapuram.* Technical Report. Kerala State Land Use Board, Thiruvananthapuram, p. 19-20

Kerala State Planning Board. 1999. *Watershed Based Development : A Handbook for Preparation of Master Plan.* Kerala State Planning Board, Thiruvananthapuram, p. 96

Kerala State Land Use Board. 2002. Recommendations of the plenary session. *State Level One day Seminar in Connection with National Land Resources Conservation Awareness Programme on "Our Land Our Future"*, January 18, 2002 (eds. Thampi, C.J.). Kerala State Land Use Board, Thiruvananthapuram, pp. 5

Kerlinger, F.N. 1983. *Foundations of Behavioural Research.* Surjeet Publications, Delhi, p. 595

Khare, A. 1976. *Innnovation Success and Creative Thinking.* Babaln Books Company, Bangalore, p. 76-77

Kher, S.K. and Patel, R.B. 2000. A study on knowledge gap at various levels of technology transfer with respect to paddy crop. *Indian. J. Ext. Edn.* 36 : 164-166

*Krech, D. and Crutchfield, R.S. 1948. *Theory and Problems of Social Psychology.* Mc Graw - Hill Book Company, New York, p. 152

Kreuger, R.A. 1988. *Focus groups : A practical guide for applied research.* Sage, London, p. 62, 80, 109

Krishna, N.D.R., Murthy, Y.V.N.K., Rao, B.S.P. and Srinivas, C.V. 2000. Geoinformatics for ecological-economic zoning towards landuse planning in Yerrakalam catchment, Andhra Pradesh. *Agropedology* 10 : 116-130

Krishnakumar, V. 1987. Farmer's knowledge level and attitude towards soil conservation practices - An analysis M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore, p. 76

Kumar and Narwade, S. 2001. Sustainable agricultural practices and people's participation. A case study. *Yojana* 45(11) : 29-32

Kumar, B. and Dhawan, K.C. 1992. Impact of land development programmes on socio-economic parameters in Kandi areas of Punjab. *J. of Rural Development*. 11 : 325-339

Kumar, P. and Reddy, M.N. 1993. Factors influencing the knowledge of dairy farmers of IRDP complexes. *J. Ext. Edn.* 4 : 671-674

Kumaraswamy, K. 2003. Eco-friendly soil productivity management for sustainable farming system. *Kissan Wld.* 30 (7) : 50-52

Kunju, V. 1989. Constraints in the utilization of development schemes by cardamom growers of Kerala. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 63-65, 77-79

Kupuswamy, B. 1964. *An Introduction to Social Psychology.* Asia Publishing House, Mumbai, p. 45-47

Kuppuswamy, B. 1984. *An Introduction to Social Psychology.* Asia Publishing House, Mumbai, p. 89

Lenin, V. and Veerabhadraiah. 1997. Technical proficiency and characteristics of extension personnel and their attitude towards broad based extension. *J. Ext. Edn.* 8 : 1549-1557

Lionberger, H.R. 1960. *Adoption of New Ideas and Practices.* Iowa University Press, USA, p. 67

Luthans, F. 1983. *Organizational Behaviour.* Mc Graw Hill International Book Company, New Delhi, p. 83-85

Majumdar, A.K. and Majumdar, P.K. 1967. Adoption and some psychological characteristics of farmers. *Indian J. Ext. Edn.* 3 : 138-142

Malhotra, S.P., Joshi, P.L. and Rao, J.S. 1974. Relative importance of some socio-economic factors in the adoption of agricultural innovations. *Indian J. Ext. Edn.* 10 : 62-64

Mandal, D.K., Kandare, N.C., Mandal, C. and Challa, O. 2002. Assessment of qualitative land evaluation methods and suitability mapping for cotton growing soils of Nagpur district. *J. Indian Soc. Soil Sci.* 50 : 74-80

Mani, K.C. 1980. Critical analysis of factors associated with participation and non-participation of turmeric growers in regulated market. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore p. 74-75

Mani, K.C. and Knight. 1981. Factors associated with participant's and non-participant's attitude towards regulated market. *Indian J. Ext. Edn.* 17 : 39-43

Manivannan, N. 1980. A study on the knowledge and extent of adoption of sunflower growers. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore. p. 69-70

Manju, V. 1997. Indigenous practices of vegetable cultivation in Thrissur district, M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 56-58

Manju, S.P. 1996. Indigenous practices in coconut farming in Thrissur district. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 87-88

Manjunath, B.N., Lekshminarayan, M.T. and Pillegowda, S.M. 1996. Knowledge of farmers on dry land farming practices. *J. Ext. Edn.* 7 : 1292-1293

Manjusha, A.R. 2000. Techno-Socio-Economic assessment of farmers practices in the cultivation of cowpea (*Vigna unguiculata* L.) in Thiruvananthapuram district. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 52, 103-106

Manoj, S. 2000. Techno-Socio-Economic assessment of farmers practices in rice cultivation in Thiruvananthapuram district, M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 62

Marimuthu, P. 2001. Indigenous tribal wisdom for rural development : A multi dimensional analysis. Ph.D. thesis, Tamil Nadu Agricultural University, Coimbatore. *P.G. thesis Abstract 1* : 123

Marshall, J.C. and Hales, L.W. 1972. *Essentials of testing*. Addison-Wesley, California, p. 81

Mary, M.L., Annamalai, R. and Muthiah, M. 1994. Agriculture farm youths (girls) attitude. *J. Ext. Edn.* 5 : 978-981

Matani, A.G. 1995. Fostering farming entrepreneurship towards rural development. *Indian J. Training and Development*. 25 : 33-41

Mathew, J. 1980. A study on the role of rural youth in agricultural development of rural areas. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p.76-77

*Mc Clelland, D.C. 1961. *The Achieving Society.* Vakils Free Press, New York, p. 196

McNeill, D. 2000. The concept of sustainable development. *Global Sustainable Development in the Twenty First Century* (eds. Lee, K., Holland, A. and McNeill, D.). Edinburgh University Press, Edinburgh, pp. 10-28

Meera, B. 1981. Impact of farm women's training in agriculture. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 49-50

Meera, B. 1995. Differential adoption of plant protection technology by farmers of Kerala. A critical analysis. Ph.D. thesis, Kerala Agricultural University, Thrissur, p. 176-178

Mishra, S.P. and Sinha, B.P. 1981. An analysis of motivational dispositions of farm entrepreneurs. *Indian J. Ext. Edn.* 19 : 46-51

Mishra, Y. 1994. People's participation in production process under watershed. *Kurukshetra* 42(11) : 28-30

*Mitchel, B. 1978. An analysis of perception of the role of subordinates with respect to authority, responsibility and delegation in community schools at the attendance centre level. Ph.D. thesis, Michigam State University, Michigam, p. 70-90

Mohanty, G. 1988. *Text book of Industrial and Organizational Psychology.*

Morgan, D.L. 1988. *Focus groups as qualitative research.* Sage, London, p. 42

*Mowday, R.T., Porter, L.W. and Busin, R. 1974. Unit performance, situational factors and employee attitude in seperated work units. *Organl. Behav. Hum. Perform.* 12 : 213-248

Mukherjee, N. 1997. *Participatory Appraisal of Natural Resources.* Concept Publishing Company, New Delhi, p. 30-31, 58-89

Murugesan, K.P. and Nanjaiyan, K. 1996. Factors influencing attitude of adult farmers towards adult education programme. *J. Ext. Edn.* 7 : 1312-1313

Muthukrishnan, S. 1981. Utilization of biogas plants - An analysis. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore, p. 60-64

Nagabhushanam, K. and Nanjaiyan, K. 1998. Farm women's attitude towards institutional training programme - An analysis. *J. Ext. Edn.* 9 : 1909-1911

Naidu, L.G.K. and Hunsigi, G. 2001. Application and validation of FAO - frame work and soil potential ratings for land suitability evaluation of sugarcane soils for Karnataka. *Agropedology.* 11 : 91-100

Nandakumar, A.C. 1980. Critical analysis of the functioning of drought prone area programme. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore, p. 87

Natarajan, A., Ramesh, M., Srinivas, S., Reddy, R.S. and Velayuthan, M. 2003. Resource appraisal for alternative land use planning in Salem district, *Madras Agric. J.* 90 : 197-206

Natarajan, K. and Thenmozhy, A. 1991. Entrepreneurial development programme for women - A case study. *Yojana* 35(8) : 6-8

Nataraju, M.S., Perumal, G. and Nagaraja, G.N. 1991. Transfer of technology in Training and Visit System. *Indian J. Ext. Edn.* 27 : 84-90

Nath, G.G. 2002. Role of labour force (Thozhil Sena) in agricultural development implemented through people's plan in Kerala. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 77-78

Negi, S.S. 2001. Experience of participation in integrated watershed development project in Himachal Pradesh. *Indian Journal of Public Administration*. 42 : 26-37

Nehru, S.M. 1993. Job efficiency of panchayat level agricultural officers of Department of Agriculture in Kerala. Ph.D. thesis, Kerala Agricultural University, Thrissur, p. 116, 118, 128-129

Nelson, A.S. 1992. Role of Krishi Bhavans in agricultural development in Thiruvananthapuram district. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 112-120

Nirmala, P. 1993. Knowledge and adoption of biofertilizers. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore, p. 85

Nizamudeen, A. 1996. A multi-dimensional analysis of 'Kuttimulla' cultivation of Alapuzha district. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 65-67

Nyonand, R.K.J. and Jha, K.K. 1999. Participatory rural appraisal analysis of Ratanpur watershed - A case study. *Indian J. Soil Conserv.* 27 : 266-269

Oakley, P. 1987. *State or process, means or end ? The Concept of participation in rural development.* RRDC Bull. 02610914, p. 3

Padmaiah, M. and Ansari, M.R. 1997. Attributes influencing the perception about usefulness of watershed development programme. *J. Ext. Edn.* 8 : 1615-1619

Panda, R.K. 2001. Mapping of coastal waterlogged area by optical remote sensing. *Indian J. Soil Cons.* 29 : 196-199

Pande, V.C., Khatik, G.L., Kurothe, R.S. and Nambiar, K.T.N. 2002. People's participation in ravine reclamation through afforestation - A case study. *Indian J. Soil Conserv.* 30 : 77-82

Pandey, S.K. and Sharma. 1990. *Universe of Knowledge and Research Methodology.* Ken Publications, New Delhi, p. 10

Parker, S. 1997. Annapurna conservation area project. In persuit of sustainable development. *Approaches to Sustainable Development* (eds. Richard, M.A. and Katrina, B.) Printer, London, pp. 144-166

Parshad, R. 1981. Correlates of knowledge of village level workers about high yielding varieties. *Indian J. Ext. Edn.* 17 : 88-91

Parthasarathi and Govind, S. 2002. Knowledge of trained and untrained farmers on IPM practices. *J. Ext. Edn.* 13 : 3293-3297

Parvathy, S. 2000. Participation of women in agricultural development programmes under people's plan in Thiruvananthapuram district. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 70-80

Patel, N. and Rajput, T.B.S. 2001. Participatory rural appraisal in watershed management - A case study. *Indian J. Soil Conserv.* 29 : 152-157

Patel, N.R., Prasad, J. and Kumar, S. 2001. Land capability assessment for land use planning using remote sensing and GIS. *Agropedology* 11 : 1-8

Perimbam, P. 1981. Transfer of farm technology in Training and Visit system. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore, p. 71

Perumal, G. and Rai, G.G. 1979. Job satisfaction and job performance of Agricultural Extension Officers working in rural development block of Tamil Nadu. *Madras Agric. J.* 65 : 96-99

Philip, H. 1995. Two dimensional and three dimensional visual for effective video programme production - An experimental study. Ph.D. thesis, Tamil Nadu Agricultural University, Coimbatore, p. 123

Prabhu, M.K.K.R. 1988. Soil conservation programme - Impact and its consequences in Nilgris. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore, p. 74-75

Prajapathi, M.R. and Patel, A.A. 1984. Attitude of extension workers towards some selected components of Training and Visit programme. *Indian J. Ext. Edn.* 20 : 55-56

Prakash, R. 1980. A study on the impact of agricultural development programmes among the tribals of Kerala. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 71-72

Prasad, M.S. and Mahipal. 1997. Impact of training programme on knowledge gain of Subject matter specialist. *J. Ext. Edn.* 8 : 1596-1599

Prasad, S. 2000. Attitude towards health, nutrition and education of girl child. *Indian J. Ext. Edn.* 36 : 79-84

Prasannakumar, R. 1985. A study on organisation commitment of extension personnel under Training and Visit system. M.Sc. (Ag.) thesis, University of Agricultural Sciences, Bangalore, p. 78-79

Preetha, L 1997. Indigenous practices in rice cultivation in Thrissur district. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 136-145

Pridhvi, M. 1996. Client's attitude and participatory plan. *Indiian J. Ext. Edn.* 30 : 24-27

Pushpa, J. and Seetharaman, R.N. 1998. Information sources utilised and awareness about rural development programmes. *J. Ext. Edn.* 9 : 1983-1987

Pushpa, R., Chandrakandan, K., Sujatha, J. and Annamalai, R. 1993. Perception on the existing research - extension - clientale linkage and feedback - a study. *J. Ext. Edn.* 1 : 624-628

Rahiman, O.A. and Menon, A.G.G. 1980. Gain in knowledge and attitude towards training of supervisors of Primary land mortgage bank. *Agric. Res. J. Kerala* 18 : 123-124

Rai, H.N. 1965. Diffusion of information and farmer's response in relation to an improved farm practices. *Indian J. Ext. Edn.* 1 : 140

Rajendralal, T.V. 1997. Multidimensional study on special component plan schemes for the scheduled caste farm families, M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 23-25

Ramachandran, K., Mishra, P.K. and Padmanabhan, M.V. 2001. Watershed development planning for semi-arid Tellengana region in India using GIS. *Indian J. Soil Cons.* 29 : 73-76

Ramachandran, K.K. and Samsuddin, M. 2002. *Micro-level resource evaluation using high resolution remote sensing (HRRS) & GIS.* CESS NEWS. 12(4) : Centre for Earth Science Studies, Thiruvananthapuram, p. 2-4

Rambalu, R. 2000. Training need knowledge assessment of Agricultural extension officers. *J. Ext. Edn.* 11 : 2890-2893

Ramulu, C.H.B. 2002. Participatory development : The experience of Andhra Pradesh. *The Indian Journal of Public Administration.* 48 : 655-668

Ranganathan, E. 1984. Aspiration of farm youth and their attitude towards farming. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore, p. 192

Rao, U.R. 1991. Space and agricultural management. *Proceedings of the 42nd IAF Congress, October 7, 1991.* (eds. Rao. U.R., Chandrasekhar, M.G., Jayaraman, V. and Rao, P.P.N.). International Astronautical Federation, Montreal, pp. 1-10

Ravichandran, V. 1980. A study on attitude, extent of adoption and problems encountered by registered sugarcane growers. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore, p. 68-69

Ray, G.L. 1997. Facilitating people's participation in rural development programmes. *Management of Agricultural Extension in Global Perspectives* (eds. Samanta, R.K. and Arora, S.K.). B.R. Publications, New Delhi, pp. 171-187

Rayapareddy, T. and Jayaramaiah, K.M. 1989. Village extension officers knowledge of rice production technology. *Indian J. Ext. Edn.* 25 : 93-95

Reddy, B.R.C. 1983. Role performance and job satisfactor of the VEOs working with intensive agricultural extension programme (T&V system). M.Sc. (Ag.) thesis, Andhra Pradesh Agricultural University, Hyderabad, p. 70-72

Reddy, K.P. 1984. Analysis of information flow and communication linkage in transfer of dairy management practices - A systems perspective. Ph.D. thesis, Andhra Pradesh Agricultural University, Hyderabad, p. 137

Reddy, M.S. and Reddy, S.V. 1977. Personal and socio-economic characteristics associated with the attitude of farmers towards crop loan system. *Indian J. Ext. Edn.* 13 : 68-70

Reddy, M.V. and Reddy, S.V. 1988. Relationship between selected characteristics of contact farmers and their knowledge and adoption of improved paddy cultivation practices. *Indian J. Ext. Edn.* 24 : 39-42

Reddy, R.S., Thayalan, S., Prasad, S.C.R., Reddy, P.S.A. and Sehgal, J.L. 1990. Utility of satellite data for land evaluation in landuse planning for a part of Northern Karnataka. *J. Indian Soc. Remote Sensing* 18(4) : 34-44

Reddy, S.M. and Iqbal, M. 1993. Knowledge of beneficiaries and non-beneficiaries on watershed development programme. *Maharastra J. Ext. Edn.* 12 : 181-184

*Rhebergen. 1987. *Land Suitability Evaluation in Botswana, Some Problems and Solution.* FAO World Soil Resources Report No. 62 FAO, Rome, p. 22-24

*Riquuier, J., Bramo, D.L. and Cornet, J.P. 1970. *A New System of Soil Appraisal in Terms of Actual Potential Productivity.* AGL TESR/7016. FAO, Rome, p. 38

Rogers, E.M. and Havens. 1961. *The impact of demonstration on farmer's attitude towards fertilizers.* Research Bulletin. Ohio Agricultural Experimental Station, Ohio, p. 891

Rossiter, D.G. 1990. ALES : A framework for land evaluation using micro computer. *Soil Use Management.* 6(1) : 7-20

Sadanandan, S. 2002. Social cost benefit analysis in vegetable production programme in Kerala through participatory approach. Ph.D. thesis, Kerala Agricultural University, Thrissur p. 146-147

Sagar, R.L., Kunzru, O.N. and Khandekar, P. 1992. A scale to measure livestock owner's attitude towards green fodder. *Indian J. Ext. Edn.* 28 : 123-126

Sahai, B. 1988. Remote sensing in rural development. *Photonirvachak* 16(4) : 4-11

Sahra, J.S. and Mishra, A.S. 1997. Watershed management : Some successful initiatives. *The Administrator* 42 : 41-54

Saijonkar, P.B. and Patel, A.D. 1970. Relation of certain factors with the success of Village level workers in Kaira district of Gujarat state. *Behavioural Science and Community Development.* 4 : 23

Saini, G.S. and Singh, S. 1996. Correlates of training needs of agriculture inspectors. *Indian J. Ext. Edn.* 32 : 73-74

Saiyadain, S.M. 1980. *Human Resource Management.* Tata Mc Graw Hill Publishing Co. Ltd., New Delhi, p. 120

Sajeevchandran, A. 1989. Impact of development programmes in promoting pepper production in Kerala. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 68-78

Salunkhe, G.V. 1978. A scale to measure small farmers attitude towards SFDA. *Indian J. Ext. Edn.* 14 : 66-69

*Salvi, P.V. 1970. *A Study of Farmers Trained at Farmers Training Centre.* A mimeographed report submitted to AGRESCO sub committee of Agricultural Extension, Economics and Statistics, Lucknow, p. 40

Samad, K.A. 1979. Response of special package programme for agricultural development in Kerala. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 26-29, 47-51

Samanta, R.K. 1991. *Agricultural Extension in Changing World Perspectives*. Uppal Publishing House, New Delhi, p. 8-12

Santhoshkumar, P. 1999. Multidimensional analysis of agricultural development programme implemented through people's plan. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 38-49

Saravanan, R., Gowda, N.S.S. and Gowda, K.N. 1999. Attitude of farmers, extension personnel and scientists towards privatization of agricultural extension service. *Indian J. Ext. Edn.* 35 : 176-180

Sawant, A.G., Warwadekar, S.C., Mahadik, R.P. and Nirban, A.J. 2000. Attitude of higher secondary school students towards agriculture course. *J. Ext. Edn.* 11 : 2754-2757

Sawer, J.B. 1973. Predictors of the farm involvement in general management and adoption decisions. *Rural Soc.* 38 : 413-425

Seema, B. 1997. Interaction of psychological, economic, sociological and technological determinants of the entrepreneurial behaviour of agricultural students. Ph.D. thesis, Kerala Agricultural University, Thrissur, p. 79, 147

Sehgal, J., Mandal, C., Singh, S.R., Chaturvedi, A., Vadivelu, S., Yadav, S.C. and Pofali, R.M. 1994. *Land Resource Atlas of Nagpur district.* Publication No. 22. National Bureau of Soil Survey and Land Use Planning (ICAR), Nagpur, p. 75

Sekhar, V. and Perumal, G. 1988. Awareness and participation of extension personnel in farm broadcast programmes. *Indian J. Ext. Edn.* 24 : 52-54,74-76

Selvakumar, B. 1988. Information support utilization for awareness, conviction and adoption of cotton whitefly control measures by contact and non-contact farmers. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore, p. 81-82

Senthil, D. 1983. A critical analysis of hybrid cotton seed growers. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore. p. 77-78

Sethy, B., Sinha, B.P. and Bahal, R. 1984. Some entepreneurial characteristics in adoption of an improved farm technology. *Indian J. Ext. Edn.* 20 : 29-37

Shao, X.N. 1984. Land evaluation in China. *Soil Survey and Land evaluation*. 4(2) : 39-43

Sharma, O.P. 1972. Comparative study of scales of Likert and Guttman - A technique of measuring attitudes of extension personnel. *Studies in Extension Education* (ed. Singh, P.R.R.). NICD, Hyderabad, pp. 120-132

Sheela, B. and Sundaraswamy, B. 1999. Knowledge level of dairy practicing women. *J. Ext. Edn.* 10 : 2448-2450

Sheela, L. 1989. Awareness and training needs of officers of Department of Agriculture in watershed planning, M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 92-104

Shiva, V. 2002. *Making farming sustainable, equitable.* The Hindu daily, 3rd October, Thiruvananthapuram, p.9

Siddaramaiah, B.S. and Gowda, N.S.S. 1987. Job perception, job performance and job satisfaction of extension guides in Karnataka. *Indian J. Ext. Edn.* 23 : 48-50

Sindudevi, P. 1994. Differential preference of work by agricultural labourers and their employment and wage pattern in Thiruvananthapuram district, M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 140

Singh, A.K. 1993. *Tests, Measurements and Research Methods in Behavioural Sciences.* Tata Mc Graw - Hill Publishing Company Limited, New Delhi, p. 55, 251-253

Singh, A.P. and Patiraj. 1987. A study on individual need strength, motivation and job involvement in relation to job satisfactor, productivity and absenteeism. *Indian J. Industrial Relations* 23 : 409-424

Singh, A.P. and Srivasthava, S. 1983. Effect of need for achievement on job performance - job satisfactor relationship. *Indian J. Industrial Relations* 18 : 437-442

Singh, G., Venkataramanen, C., Sastry, G. and Joshi, B.P. 1994. *Manual of Soil and Water Conservation Practices.* Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, p. 328, 339-347

Singh, K.M.P. and Singh, R.P. 1974. Impact of national demonstration in adoption of H.Y.V of wheat. *Indian J. Ext. Edn.* 10 : 65-67

Singh, K.P. 1993. Women entrepreneurs, their profile and motivation. *The Journal of Entrepreneurship* 2(1) : 47

Singh, P.R.R. and Singh, P.R.A. 1983. A study of the attitude of farmers of Chhotanagpur towards soil conservation programme. *Indian J. Ext. Edn.* 20 : 9-17

Singh, R. 1970. Achievement motivation among agricultural and business entrepreneurs of Delhi. *Journal of Social Psychology.* 81 : 146-149

Singh, R.K., Kumari, K. and Singh, R.P. 1999. Farmer's knowledge of late sown wheat production technology. *Indian J. Ext. Edn.* 35 : 255-258

Singh, S.N. 1974. Achievement motivation scale. *Hand Book of Psychological and Social Instruments* (eds. Pareek, V. and Rao, T.V.). Samasht, Baroda, pp. 218

Singh, S.N. and Singh, K.N. 1970. A multi variable analysis of adoption behaviour of farmers. *Indian J. Ext. Edn.* 6 : 39-44

Singh, S.N. and Sinha, B.P. 1970. Attitude measurement by sematic differential technique. *Indian J. Ext. Edn.* 6 : 71-74

Singh, S.P. 2002. Agroecosystem analysis. *Management Development for Sustainable Agricultural Production.* (ed. Singh, B.). ICAR Winter School, September 10-30, 2002. IARI, New Delhi, pp. 24-32

Singh, S.P., Hudda, R.S. and Verma, H.K. 1991. Knowledge gap of citrus growers. *Indian J. Ext. Edn.* 27 : 117-120

Singh, S.V. 1999. Watershed management - A holistic approach to improve socio-economic status of the farmers. *Indian J. Soil Cons.* 27 : 243-245

Sivanapan, R.K. 2002. Watershed management practices in India – Problems and constraints. *Watershed Management Practices in India* (eds. Vijayananand S.M., Jain, P.C., Premachandran, P.N., Bose, V.S.C. and Viswanathan, C.R.) Western Ghat Cell, Planning and Economic Affairs Department, Government of Kerala, Thiruvananthapuram, pp. 1-18

Sivanappan, R.K. 2002. Watershed development and management - practical issues. *Watershed Based Development and Management : A compendum of selected articles on watershed based development and management.* (eds. Vijayananand, S.M., Premachandran, P.N. and Jain, P.C.) Western Ghat Cell, Planning and Economic Affairs Department, Government of Kerala, Thiruvananthapuram, pp. 24-33

Skole, D.L., Chomentowski, W.A., Sallas, W.A. and Norbe, A.D. 1994. Physical and human dimensions of deforestation in Amazonia. *Bioscience* 44 : 314-322

Smyth, A.J. and Dumanski, J. 1995. A framework for evaluating sustainable land management. *Canadian J. Soil Sci.* 75 : 401-406

Sreedaya, G.S. 2000. Performance analysis of self help groups involved in vegetable production in Thiruvananthapuram district, M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 70, 154

Sridhar, G. 1977. An analysis of communication pattern of personnel in extension and client system - A system approach. M.Sc. (Ag.) thesis, University of Agricultural Sciences, Bangalore p. 89-90

Srinath, K. 1988. Awareness and attitude of prawn farmers towards scientific prawn fishing. *Indian J. Ext. Edn.* 24 : 74-76

*Stephenson, W. 1936. Introduction to inverted factor analysis with some applications to studies in orexis. *Journal of Educational Psychology.* 27 : 353-367

*Storie, R.E. 1933. *An Index for Rating Agricultural Values of Soils*. Technical Bulletin. California Agricultural Experiment Station, California, p. 556

Subalekshmi, N. and Singh, A.D. 1974. Job satisfaction of Gramasevikas. *Kurushetra*. 22(11) : 12

Subbaraj, V.K. 1980. An analysis of credit repayment behaviour of farmers. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore. p. 82-83

Sudha, V.K. 1987. A study of the impact of lab to land programme of tribal and non-tribal participants in Kerala Agricultural University. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 62-68

Sumana, A. and Reddy, M.V. 1998. Awareness of farm women about technologies of watershed development projects in Prakasam district of Andhra Pradesh. *Andhra agric. J.* 45 : 25-30

Surendran, G. 2000. Participatory group approach for sustainable development of agriculture in Kerala. Ph.D. thesis, Kerala Agricultural University, Thrissur, p. 125, 127, 280

Sureshkumar, B. and Venkataramaiah, P. 1992. Attitude of beneficiaries towards Jawahar Rozgar Yojana. *Indian J. Ext. Edn.* 28 : 111-113

Sushama, N.P.K. 1979. A study on the impact of selected development programmes among the tribals of Kerala. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 113-114

Swaminathan, M.S. 1991. The environment scene : maladies and remedies. *Survey of the Environment 1991*. (ed. Ravi. N.) The Hindu, Chennai, p. 4-7

Syamala, K.S. 1988. An analysis of the effectiveness of national demonstration conducted by Kerala Agricultural University, M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 123,127

Sys, C. Ir. 1985. *Land Evaluation, Part III*. General Administration for Development Co-operation, Brussels, Belgium, p.248-331

Taylor, A., Rosegrant, T., Mayee, A. and Samples, B.T. 1980. *Communicating*. Prentice Hall International Inc., London, p. 82

Thenmathi, N. 2001. Functioning of farmer's market (Uzhavar Sandhai) - A critical analysis. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore. *P.G. thesis Abstract 1* : 82

Theodore, R. 1988. Awareness, conviction and adoption of technological units and contingency farming practices of rice by contact and other farmers of Thanjavoor district. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore, p. 76, 89-90

Thomas, A. 2000. Problems and prospects of medicinal plant collection in Thiruvananthapuram district. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 45-46, 110

Thurstone, L.L. 1946. *The Measurement of Attitude*. University of Chicago Press, Chicago, p. 193

Tomar, J.M.S., Satapathy, K.K. and Dhyani, S.K. 2002. Integrated approach of RS & GIS in characterization and evaluation of natural resources for watershed management in Upper Shipra watershed, Meghalaya. *Indian J. Soil Cons.* 30 : 206-213

Tripathi, H. and Kunzru, O.N. 2000. Dairy farming : An attitudinal profile of rural women. *J. Ext. Edn.* 11 : 2754-2757

Turton, C. and Reddy, M. 1998. *Report of a study on the Impact of Watershed Development in Andhra Pradesh.* Technical Report. ODI, London, p. 30

UNDP. 1993. *Human Development Report - 1993.* Oxford University Press, Oxford, p. 21

*UNO. 1979. *1978. Report on the World Social Situation.* Technical Report. UNO, New York, p. 225

Varadan, V.K.S. 1987. Perspective of land management in the context of scientific management of environment and remote sensing. *Proceedings of National Symposium on Remote Sensing in Land Transformation and Management.* December 21-23, 1987 (eds. Bhan, S.K. and Jha, V.K.). Indian Society of Remote Sensing, pp. 11-21

Varma, P.H. 1996. A multi-dimensional analysis of self employment among farm women. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 47-56

Varma, V. and Chauhan, R.K.S. 1998. Natural development of waterlogged eco-system for sustainable production. *J. Soil Wat. Conserv.* 42 : 62-67

Varma, V. and Singhal, V.K. 1998. Sustainable development of flood prone watershed in Gangetic plain. *J. Soil Water Cons.* 42 : 80-83

Veeriah, A., Daivadeenam, P. and Pandey, R.N. 1998. Knowledge and adoption level of farmers trained in Krishi Vigyan Kendra about groundnut cultivation. *Indian J. Ext. Edn.* 34 : 58-63

Venkataraman, A. 2002. How do we respond to the emerging environment ?. *Survey of Indian Agriculture 2002.* (ed. Ravi. N.) The Hindu, Chennai, p. 23-25

Venugopal, M. and Perumal, G. 1992. Applicability of dry land technologies as viewed by extension personnel. *Indian J. Ext. Edn.* 28 : 22-27

Verheye, W.H. 1987. Land suitability evaluation in major agroecological zones and its application in land use planning and nature protection. *Scientific Basis for Soil Protection in European Community.* (eds. Bath, H.L. and Hermile, P.) Applied Science Publishers, Barkin, Essex, UK, pp. 377-388

Verheye, W.H. 1993. Land evaluation for resource management and land use planning, a conceptual approach. *Agropedology* 3 : 1-12

Verheye, W.H. 2000. Use of land evaluation techniques to assess the market value of agricultural land. *Agropedology* 10 : 88-100

Verheye, W.V. 1991. Soil survey interpretation, land evaluation and land resource management. *Agropedology* 1: 17-32

Vijayakumar, P. 1983. Impact of Special Agricultural Development Units on agricultural development of rural areas of Kerala. M.Sc. (Ag.) thesis, Kerala Agricultural University, Thrissur, p. 86-87

Vijayalayam, R. 2001. A study on awareness, knowledge and adoption of eco-friendly agricultural practices in rice. M.Sc. (Ag.) thesis, Tamil Nadu Agricultural University, Coimbatore. *P.G. thesis Abstract 1* : 123

Waghmare, R.R., Kulkarni, R.R. and Thombre, B.M. 1988. A study of the awareness of horticultural development programme among fruit and vegetable growers. *Maharastra J. Ext. Edn.* 7 : 144-151

Whyte, W.F. 1991. *Participatory Action Research*. Sage Publication, New Delhi, p. 10-11

Williams, M.S. 1958. Farmers decisions in the use of fertilizers. *J. Frm. Econ.* 40 : 1407-1417

Wright, L.E. 1984. Agricultural land evaluation and site assessment (LESA) : a new agricultural land protection tool in USA. *Soil Survey and Land evaluation* 4(2) : 25-38

Yadav, R.C. and Bhushan, L.S. 2001. Watershed management redefined - a new proposition. *Indian J. Soil Cons.* 29 : 95-106

* Originals not seen

APPENDICES

Appendix – I

Selected Biophysical / Socio-economic factors of land evaluation for crop suitability

1. **Physiography:** Refers to the physical location of a surface area of land on the earth surface including its relief or relative elevation, expressed as valley, foot slope, side slope and submit (hill top).

2. **Guidance and Supervision:** Refers to the extent of technical advice, guidance and supervision provided by the extension staff to the farmers for agricultural development activities as perceived by the farmers.

3. **Elevation:** Refers to the altitude or height of a land unit with respect to mean sea level expressed in meters.

4. **Achievement motivation:** Refers to the motive or desire within the farmers to successfully select the crops in order to attain sustainable farming systems.

5. **Slope:** Refers to inclination of the land surface and is expressed in percentage.

6. **Information seeking behaviour:** Refers to the tendency, habit or desire of the farmers to collect information from all possible sources regarding scientific crop management.

7. **Soil colour:** Refers to the colour of the soil which varies from black, dark brown, red, reddish brown, yellow, bluish green, greenish grey and grey to white. It indicates important aspects of soil condition.

8. **Technical competency:** Refers to the extent in which the farmers posses knowledge in the different aspects of scientific and sustainable crop management.

9. **Farming experience:** Refers to the completed years of experience of the farmer in farming activities.

10. **Soil texture:** Refers to the feel of the soil eg: soapy, gritty, sticky etc. It is the expression of the distribution of various particle sizes present in soil. It reflects the percentage of sand, silt and clay in the soil.

11. **Economic motivation:** Refers to the extent to which the farmers are oriented towards achievement of maximum profit from farming activities.

12. **Soil structure:** Refers to the combination or arrangements of primary soil particles into secondary particles, units or peds and is expressed as platy, prismatic, blocky, columnar, massive etc.

13. **Need fulfilling:** Refers to the extent to which the actual needs of the farmers are satisfied.

14. **Scientific orientation:** Refers to the extent to which the farmers are oriented to the use of scientific crop selection and management.

15. **Soil pH:** Refers to the reaction of soil as expressed in terms of pH. It is expressed as neutral soils with pH 7, acidic soils with pH < 7 and alkaline soils with pH > 7.

16. **Soil depth:** Refers to the depth of weathered part above the unweathered part. It ranges from very shallow to very deep.

17. **Risk orientation:** Refers to the magnitude to which the farmers are oriented towards risks and uncertainty in adopting new crops and farming practices.

18. **Self sufficiency:** Refers to the extent to which the farmers are self sufficient in meeting their basic needs like food, clothing and shelter for day to day life.

19. **Soil drainage:** Refers to the quality or state of a soil or any horizon in soil profile relating to transmission of water to all parts of the mass.

20. **Major occupation:** Refers to the primary occupation of the people of the study area.

21. **Self reliance:** Refers to the extent to which the farmers relies on self for their future.

22. **Soil erosion:** Refers to the process of detachment and movement of soil from land surface by wind or running water. It usually ranges from nil to very severe.

23. **Major nutrients:** Refers to the availability of elements such as N, P and K in the soil that can be readily absorbed and assimilated by growing plants.

24. **Credit orientation:** Refers to the favourable and positive attitude of the farmers towards obtaining credit from institutional sources for agriculture development activities.

25. **Perceived knowledge level:** Refers to the thorough knowledge and understanding of the farmers about different crops, their suitability to different agro-climatic situations and their management.

26. **Presence of rocks/gravels/stones:** Refers to the soil surface stoniness or rockiness which is a terrain attribute. It is expressed in percentage to surface cover.

27. **Soil moisture:** Refers to the water held with in the soil column.

28. **Soil organic matter:** Refers to the organic fraction of the soil. It includes plant and animal residues at various stages of decomposition.

29. **Social participation:** Refers to the extent and nature of involvement of the farmers in various activities of both formal and informal social organizations as members or office bearers.

30. **Capacity building:** Refers to the ability building capacity of the farmers to achieve sustainability from farming activities in order to achieve their goals.

31. **Soil mineral matter:** Refers to the mineral matter contained in the soil. It comes from the rocks from which the soil is formed. It varies according to the chemical composition of the parent rock.

32. **Soil salinity:** Refers to the concentration of highly soluble salt in the soil. These soils have conductivity of the saturation extract more than 4 deci siemens/mol and exchangeable sodium percentage > 15.

33. **Mass media exposure:** Refers to the extent to which the farmers are exposed to different mass media communications such as news paper, radio, television, films and bulletins.

34. **Initiative:** Refers to the capacity of the farmers to come forward on their own to take up some activity related to crop management.

35. **Innovativeness:** Refers to the degree to which the farmers are relatively earlier in adopting new ideas in crop management.

36. **Temperature:** Refers to the mean atmospheric temperature prevailing in an area, and is expressed in ^{o}C.

37. **Cation exchange capacity (CEC):** Refers to the amount of exchangeable cations that a soil can absorb, expressed in milli equivalents per 100 grams of soil or of other absorbing mineral such as clay. It is a measure of the potential of soil to hold nutrient cations for plant absorption.

38. **Soil temperature:** Refers to the temperature value in the soil at any time and at every location in the root zone of the plants being grown.

39. **Rainfall:** Refers to the average annual precipitation received over a period of time in an area.

40. **Extension participation:** Refers to the involvement of the farmers in the various extension activities such as meetings, seminars, discussions etc related to crop production.

41. **Crop appropriability:** Refers to how far a crop suits the social and infrastructural situation of the farmers in an area.

42. **Economic feasibility:** Refers to whether farmer can afford to undertake cultivation of a crop within their financial status and position.

43. **Economic viability:** Refers to whether the crop can bring positive net returns to the farmers.

44. **Increase in productivity:** Refers to the increase in crop yield from unit area of land.

45. **Rainfall distribution:** Refers to the amount of rainfall received at periodic intervals namely NE monsoon period, S.W. monsoon period and summer season.

46. **Social acceptability:** Refers to the extent to which a crop is acceptable to the different sections of the society.

47. **Local adaptability:** Refers to the extent to which a crop is adaptable to the existing local conditions of the farmers and agro-ecological situations.

48. **Infrastructural facilities:** Refers to the availability and adequacy of facilities such as electricity, communication, roads, machinery, pump houses etc to undertake and manage scientific crop production.

49. **Solar radiation:** Refers to the radiant energy from the sun measured as a total amount expressed in cal/cm/hour.

50. **Environmental soundness:** Refers to whether the cultivation of a crop results in enriching the environment or atleast it does not harm the environment.

51. **Temporal stability:** Refers to whether the positive aspect of cultivating a crop remain stable over a long period of time.

52. **Cultural desirability:** Refers to the extent to which a crop fits with the cultural values of the society.

53. **Employment generation:** Refers to the extent to which additional employment opportunities can be generated by adopting a sustainable crop recommendation.

54. **Ground water:** Refers to the rain water which has percolated through the soil to under ground rock strata and serves as the water source of wells, ponds and springs. It can be expressed in terms of potential.

55. **Entrepreneurial behaviour:** Refers to the ability of farmers to exploit opportunities and initiate activities to increase income from crop enterprise.

56. **Average size of holdings:** Refers to the average size of land holdings possessed or owned by the farmers.

57. **Resource use efficiency:** Refers to how efficiently a crop can utilize the available natural resources or inputs to convert them into useful and productive outputs.

58. **Management orientation:** Refers to the extent to which the farmers are scientifically oriented towards planning, cultivation, production and marketing aspects of crop enterprise.

59. **Labour need:** Refers to the farmers perception on the labour requirement for a new sustainable crop enterprise.

60. **Land use/Land cover:** Refers to the existing land use/land cover pattern and their spatial distribution on the land surface.

61. **Training participation:** Refers to the extent of involvement of farmers in the training programmes conducted by the different extension and rural development agencies.

62. **Indebtedness:** Refers to the extent of financial debt of the farmers to various money lending sources such as private lenders, cooperatives, traders and banks as per available records.

63. **Orientation towards incentives:** Refers to the orientation of the people towards subsides and assistance provided by the Government and other sponsoring agencies to motivate farmers to follow scientific crop management.

64. **Relative humidity:** Refers to the water vapour content of the atmosphere in an area.

65. **Involvement in decision making:** Refers to the involvement of farmers in generation of ideas, evaluation of options and making choice from among options in crop enterprise.

66. **Evapo-transpiration:** Refers to the loss of water from an area (eg: a field) by evaporation at the soil surface and by plant transpiration.

67. **Satisfaction:** Refers to the extent to which the farmers achieve happiness by adopting scientific crop selection and their management.

68. **Wind velocity:** Refers to speed of the wind expressed in Km/hr. It is measured by anemometer.

69. **Conservatism:** Refers to the positive attitude of the farmers towards traditional system of crop management.

70. **Wind direction:** Refers to the direction at which the wind blows and is indicated by an instrument called windvane.

71. **Participation in PTD:** Refers to the process of purposeful and creative interaction between the farmers and outside facilitators in order to strengthen the capacity of farmers and enable them to analyse the existing system and to develop relevant, feasible and useful innovation in crop management.

72. **Orientation towards competition:** Refers to the extent to which the farmers are oriented to place them in a competitive situation in relation to other farmers for projecting their excellence in crop selection and management.

73. **Surface water:** Refers to the water unable to penetrate through and it finds its way to drainage channel, streams and rivers via the surface of soil.

74. **Sustained profit:** Refers to the extent to which the crop enterprise provide continued profits and monetary benefits to the farmers.

75. **Political determinism:** Refers to the extent to which over emphasis is given to political considerations in crop selection.

76. **Cropping intensity:** Refers to the proportion of total annual cropped area to the total geographical area, which is expressed in percentage.

77. **Group cohesion:** Refers to the extent to which the farmers are affiliated to one another and are motivated to remain in group.

78. **Canopy density:** Refers to the percentage of plant canopy coverage over an unit area of land. It will be expressed as High (>40% canopy cover), Medium (40% - 10% canopy cover) and Low (< 10% canopy cover).

79. **Market access:** Refers to the nearness of the market with respect to the farmers field for selling the agricultural produce.

80. **Market demand:** Refers to the consumer demand for the different agricultural produce in both internal or external markets.

Appendix – II

KERALA AGRICULTURAL UNIVERSITY

Department of Agricultural Extension
College of Agriculture
Vellayoni - 695 522.
Date : 09.04.2003

Dr. N. P. Kumari Sushama
Associate Professor

Dear Sir/Madam,

Shri. K. Abdul Samad, Ph.D. Scholar of this Department under my guidance has taken up a study titled **'Development of spatial crop suitability model through participatory and integrated land evaluation for sustainable agriculture'** as part of his doctoral research programme'.

One of the important component of the study is identification of the most important biophysical and socio-economic factors to be considered for land evaluation at micro watershed level in the context of sustainable agriculture development in Kerala.

This will be done using the technique of Pusa Rank Sheet for Q-sort developed by Babu and Singh (1984).

In this effort, considering your vast knowledge and experience you have been identified as one of the judges to do the rating. The Pusa Rank Sheet, the set of 80 factors/items printed on cards to be ranked and the instruction to do the ranking are enclosed.

Kindly go through the items and instructions and furnish your opinion by ranking the items in the given rank sheet. Please treat this exercise as purely an academic one and it will not be used for any official purpose.

I once again request that inspite of your busy pre-occupation you may please spare some time to help the researcher in identifying the critical factors for land evaluation. The rank sheet alone may please be mailed back to the researcher in the self addressed stamped envelope at your earliest convenience.

With regards,

Yours sincerely,
sd/-
N.P. Kumari Sushama

PUSA RANK SHEET

1. ☐☐☐☐
   A(i) MOST IMPORTANT

2. ☐☐☐☐☐☐
   A (ii) HIGHLY IMPORTANT

3. ☐☐☐☐☐☐☐☐☐
   A(iii) VERY IMPORTANT

4. ☐☐☐☐☐☐☐☐☐☐☐☐☐
   B(i) QUITE IMPORTANT

5. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐
   B (ii) SOMEWHAT IMPORTANT

6. ☐☐☐☐☐☐☐☐☐☐☐☐☐
   B (iii) SLIGHTLY IMPORTANT

7. ☐☐☐☐☐☐☐☐☐
   C (i) OF LITTLE IMPORTANCE

8. ☐☐☐☐☐☐
   C(ii) OF VERY LITTLE IMPORTANCE

9. ☐☐☐☐
   C(iii) LEAST IMPORTANT

P.S : Please make sure all blocks are filled in

Name... Designation ....

INSTRUCTION SHEET

Please sort out the 80 items in 9 groups in order of their importance for **identifying the most important bio-physical/social/economic parameters to be considered in land evaluation for sustainable agriculture development at micro watershed level.** For sorting these items, strictly follow the following steps.

Step I : Read all the 80 items carefully.

Step II : Classify all the 80 items into 3 categories in order of their importance according to the following distribution.

Category A	Most important factors	19 items
Category B	Important Factors	42 items
Category C	Least important Factors	19 items
	Total	80

In order to categorize like above follow these steps.

(a) Out of the 80 items place 19 items which you think are the 'Most Important Factors' associated with Land evaluation for sustainable agriculture development at microwatershed level. (These 19 items will constitute Category-A).

(b) From the remaining 61 items select 19 items which you think are the 'Least Important Factors' associated with Land evaluation for sustainable agriculture development at microwatershed level (These 19 items will constitute Category -C).

(c) The rest 42 items fall between the most important factors (Category-A) and the least important factors (Category-C). These 42 items will constitute Category-B.

P.S. : The serial numbers on the top comer of the cards do not have any significance in sorting out the cards. These are only identification symbols. (Code numbers)

Step III : Now take up the 19 items of Category -A and classify them into 3 sub categories. The distribution of items in the sub categories will be as follows:

Sub category number	Degree of importance	Number of items to be grouped in the sub category
A (i)	Most important factors	4 items.
A (ii)	Highly Important Factors	6 items
A (iii)	Very important Factors	9 items
	Total	19

Please follow these steps, in order to categorise as above :

(a) Place 4 items which you think are the 'Most Important factors' (among the 19 factors of Category - A) associated with land evaluation for sustainable agriculture development at microwatershed level. These 4 items will constitute sub-category number A(i). Please keep the card 'MOST IMPORTANT ie., sub category A (i) on the top and tie with the rubber band supplied.

(b) Then select 9 items out of the remaining 15 items which you think are the least important factors among the items falling in Category-A. These 9 items will constitute sub category A (iii). Please keep the card 'VERY IMPORTANT' ie., sub category A (iii) on the top and tie with the rubber band supplied.

(c) The rest 6 items of Category A will fall between sub categories A (i) and A (iii). These 6 items will constitute the sub category A (ii). Please keep the card 'HIGHLY IMPORTANT' ie., sub category A (ii) and tie with the rubber band supplied.

Step IV : Follow the same procedure as you did in step No.111 and classify the 42 items of Category - B in sub categories according to the following distribution.

Sub category number	Degree of importance	Number of items to be grouped in each sub category.
B (i)	Quite Important	13 items
B (ii)	Some what Important	16 items
B (iii)	Slightly Important	13 items
	Total	42

Please keep the respective sub category title cards on the top of each sub category and tie with the rubber bands supplied.

Step V : Following the same procedure of Step No.111 and IV, classify the remaining 19 items of category -C in 3 Sub categories as follows:

Sub category number	Degree of importance	Number of items to be grouped in each sub category
C (i)	Of little Importance	9 items
C (ii)	Of very little importance	6 items
C (iii)	Least importance.	4 items
	Total	19

Please keep the respective sub category title cards on the top of each sub category and tie with the rubber bands supplied.

Step VI	:	Take a further look at the cards already grouped and see whether it is alright from your point of view. If not, make slight adjustments till you are satisfied.
Step VII	:	Now, enter the code numbers of the grouped cards in the Rank Sheet carefully in the blocks provided under each of the 9 categories.
Step VIII	:	Mail back ONLY the Rank Sheet in the enclosed self addressed stamped envelope.

Appendix - III

KERALA AGRICULTURAL UNIVERSITY

Department of Agricultural Extension
College of Agriculture
Vellayani - 695 522.
Date 09.04.2003

Dr. N. P. Kumari Sushama
Associate Professor

Dear Sir/Madam,

Shri. K. Abdul Samad, Ph.D. Scholar of this Department under my guidance has taken up a study titled **'Development of Spatial crop suitability model through participatory and integrated land evaluation for sustainable agriculture'** as part of his doctoral research programme.

In this study 'Land evaluation' is the assessment of a land unit in terms of bio-physical, social and economic considerations in order to cultivate the best suited crop on it for sustainable agriculture. In this effort the knowledge and attitude of the agricultural officers towards Land evaluation is very vital.

As part of his study the researcher is developing (a) test to measure Knowledge level of Agricultural, Officers towards land evaluation. (b) Scale to measure Attitude of Agricultural Officers towards land evaluation for crop suitability. Considering your experience in the field of agricultural development in the State, you have been identified as one of the respondent for the purpose.

Kindly go through the given statements/items and select the appropriate ones. Please treat this exercise as purely academic one and it will not be used for any official purpose. Inspite of your pre-occupations, kindly spare some time to give your valuable judgement and kindly return the same to the researcher in the self addressed stamped envelope at the earliest.

With regards,

Yours sincerely,

sd/-

Dr. N.P. Kumari Sushama

A. Knowledge of Agricultural Officers on land evaluation for sustainable agriculture development

Below are given certain items to assess your knowledge on Land evaluation for sustainable agriculture. Please tick (✓) the appropriate ones.

1. Land evaluation needs information on
   (a) land (b) landuse
   (c) economics (d) all the three

2. A mapped area of land with specified land qualities and land characteristics is termed as
   (a) Land form unit (b) Geographical unit
   (c) Land unit (d) Geomorphic unit

3. An area of land with a recurring pattern of topography, soils and vegetation and with relatively uniform climate is called.
   (a) Land unit (b) Land system
   (c) Land form unit (d) Land use unit

4. Growing two or more crops in sequence on the same field per year is termed as
   (a) relay cropping (b) crop rotation
   (c) sequential cropping (d) multiple cropping.

5. An area of land with climate, land forms, soil and vegetation characteristics which for all practical purposes are considered as uniform is termed as
   (a) land system (b) land facet
   (c) land element (d) landuse unit.

6. Which of the following is best to differentiate between major climatic regions for land evaluation
   (a) altitude (b) temperature regime
   (c) maximum temperature (d) minimum temperature

7. How many land classes are there in the land capability classification.
   (a) Four (b) Six
   (c) Eight (d) Ten

8. Land capability classification is based on
   (a) agro-climatic situation (b) potentiality of land
   (c) permanent physical limitations (d) topography of the land.

9. Which of the following land capability class is best suited for agriculture.
   (a) Class II land (b) Class VII land
   (c) Class X land (d) none

10. Terminology for land quality which adversely affect the potential of land for a specified kind of use.
    (a) land facet (b) limitation
    (c) Critical factor (d) none

11. As per the FAO framework of land evaluation, the number of land suitability classes are
    (a) seven (b) two
    (c) five (d) eight

12. As per the FAO framework, which is the most important parameter for determining the land suitability sub classes.
    (a) soil structure (b) inputs
    (c) elevation (d) moisture deficiency

13. The number of crops harvested in relation to the years in cropping cycle is termed as
    (a) cropping duration (b) cropping intensity
    (c) cultivation factor (d) cropping index

14. Distribution of various particle size in the soil is expressed as
    (a) soil profile (b) soil structure
    (c) soil texture (d) soil particle size

15. Saline soils have exchangeable sodium percentage
    (a) < 15 (b) > 15
    (c) >25 (d) <10

16. Sandy soils are
    (a) light soils (b) medium soils
    (c) heavy soils (d) none

17. The cat ion exchange capacity (CEC) of organic soils will be
    (a) low (b) very low
    (c) medium (d) high

18. The best suited soil texture for rice crop is
    (a) sandy (b) sandy loam
    (c) silty clay (d) gravelly clay loam

19. Coconut does not thrive if the mean annual temperature is
    (a) below 25°C (b) below 30°C
    (c) below 20°C (d) below 35°C

20. Pepper can be cultivated upto an altitude of
    (a) 500m above MSL (b) 1000m above MSL
    (c) 1500m above MSL (d) 2000m above MSL

21. The optimum pH range for rubber is
    (a) 4.0 to 5.0 (b) 5.0 to 6.0
    (c) 6.5 to 7.5 (d) 8.0 to 8.5

22. The optimum soil drainage condition required for banana is
    (a) Excessive drainage (b) Moderate drainage
    (c) Imperfect drainage (d) Good drainage

3. Vanilla is a
   (a) Shade tolerant crop
   (b) Shade loving crop
   (c) Sunlight loving crop
   (d) None

24. The seeds of Bhindi (Ladies Finger) will not germinate
   (a) below 10°C
   (b) below 15°C
   (c) below 20°C
   (d) below 25°C

25. A land with 'Land irrigability' sub class '6' land is
   (a) good for irrigation
   (b) unsuitable for irrigation
   (c) marginally suitable for irrigation
   (d) moderately suitable for irrigation

B. Attitude of Agricultural Officers towards Land evaluation for crop suitability

Please indicate your extent of agreement/disagreement to the following statements by putting tick mark (✓) in the appropriate column (SA - strongly agree, A - Agree, UD - undecided, DA -Disagree, SDA - Strongly disagree)

Sl. No.	Statements	SA	A	UD	DA	SDA
1	Land evaluation ensures scientific crop suitability recommendations					
2	Land evaluation for crop suitability ensures more profit.					
3.	Land evaluation for crop suitability ensures food security.					
4.	Land evaluation for crop suitability avoids failures in crop management.					
5.	Land evaluation is not a must for crop suitability decision.					
6.	Land evaluation for crop suitability ensures resource based planning.					
7.	Farmers should adhere to the recommendation of land evaluation for crop selection.					
8.	Land evaluation for crop management ensures preservation of the environment.					
9.	Land evaluation for crop suitability is essential for sustainable agriculture development.					
10.	Land evaluation for crop suitability checks land degradation.					
11.	Land evaluation is useless, since it is not applicable to all types of crop selections.					
12.	Land evaluation for crop suitability helps to increase employment opportunities.					
13.	Land evaluation for crop suitability help the farmers to minimize unnecessary expenditure.					
14.	Land evaluation for crop suitability will bring out a new outlook in agriculture development.					

15.	Agriculture development activities must be implemented only after land evaluation					
16.	Land evaluation for crop suitability is a pre-requisite for watershed management.					
17.	Land evaluation for crop suitability does not help farmers to solve the problems in farming.					
18.	Land evaluation for crop suitability will help the farmers in sharing of available resources.					
19.	Land evaluation for crop suitability is the only way for profit making from limited available resources.					
20.	In view of the dynamic nature of land utilization, a farmer must accept land evaluation for crop suitability					
21.	Land evaluation is the only solution for location specific crop recommendation.					
22.	The effort spent on land evaluation for crop suitability is not worth the profit obtained					
23.	Following land evaluation for crop suitability is the way to prosperity.					
24.	Land evaluation for crop suitability is the only hope for feeding the growing population.					
25.	Farmers following the recommendations of land evaluation will be better off than other farmers.					
26.	There is nothing new in land evaluation for crop suitability than the age old practice of crop selection by farmers					
27.	Top priority must be given by the Department of Agriculture in developing land evaluation skills among extension personnel.					
28.	Agricultural extension personnel should feel proud in using land evaluation procedures for crop suitability recommendation.					
29.	Land evaluation for crop management does not guarantee the farmers to make profit.					

30.	The traditional way of crop selection is still the best way for crop suitability.					
31.	Land evaluation procedures for crop suitability are very difficult to understand.					
32.	Land evaluation for crop suitability is the way to raise the standard of living of farmers.					
33.	Land evaluation for crop suitability lacks flexibility for deciding the crops to be grown in a locality.					
34.	Land evaluation for crop suitability is not a pragmatic concept to practice in the field					
35.	Extension personnel feel confident in crop suitability recommendations developed through land evaluation					
36.	Land evaluation technique for crop suitability does not help farmers in facing adverse situation					
37.	The risk involved in the present day in crop selection can be overcome by land evaluation.					
38.	As land evaluation involve scientific assessment, it is beyond the reach of farmers.					
39.	Land evaluation is a good tool for taking right type of decision in crop selection.					
40.	Land evaluation for crop suitability is a wasteful exercise since crop production is predetermined by God.					
41.	Land evaluation alone gives the fitness of a given piece of land for a definite land use.					
42.	Land evaluation for crop suitability is suited only for resource rich farmers.					
43.	Land evaluation allows the intentive integration of many aspects of benefits, social, environment and economic.					
44.	Land evaluation can alone help to improve the farmers competency in crop management.					

Appendix - IV

Difficulty index (ρ) and Index of discrimination (V) of non-sample respondents for knowledge test

Item No. in non-sample respondents	N_U	N_L	R_U	R_L	$\rho = \frac{R_U + R_L}{N_U + N_L}$	$V = \frac{R_U - R_L}{N_U}$
1	10	10	9	5	0.70	0.40
2	10	10	2	1	0.15	0.10
3	10	10	1	0	0.05	0.10
4	10	10	5	1	0.30	0.40
5	10	10	50	1	0.30	0.40
6	10	10	6	0	0.30	0.60
7	10	10	9	2	0.55	0.70
8	10	10	6	0	0.30	0.60
9	10	10	8	1	0.45	0.70
10	10	10	4	2	0.30	0.20
11	10	10	3	0	0.15	0.30
12	10	10	4	2	0.30	0.20
13	10	10	5	1	0.30	0.40
14	10	10	8	5	0.65	0.30
15	10	10	9	1	0.50	0.80
16	10	10	10	8	0.90	0.20
17	10	10	8	4	0.60	0.40
18	10	10	7	3	0.50	0.40
19	10	10	6	8	0.70	0.20
20	10	10	4	8	0.60	0.40
21	10	10	3	6	0.45	0.30
22	10	10	10	10	1.00	0
23	10	10	10	10	1.00	0
24	10	10	1	0	0.05	0.10
25	10	10	5	1	0.30	0.40

Items with 'ρ' value between 0.30 and 0.70 and Net D (V) value ≥ 0.40 were considered for final test. The items selected were 1, 4, 5, 6, 7, 8, 9, 13, 15, 17, 18, 20, 25 (13 nos.)

Appendix – V

KERALA AGRICULTURAL UNIVERSITY

No.Ext. 5/2003

Department of Agricultural Extension
College of Agriculture
Vellayani - 695 522
20-06-2003

Dr. N. P. Kumari Sushama
Associate Professor (Agrl. Extn.)

Dear Sir / Madam

Sub :- KAU - Academic - Ph.D. research programme of Shri. K. Abdul Samad - reg -

Please find enclosed a questionnaire regarding the Ph.D. research work of Shri. K. Abdul Samad who has taken up a study titled **'Development of spatial crop suitability model through participatory and integrated land evaluation for sustainable agriculture'** under my guidance.

I request you to kindly spare some of your precious time to answer the items in the questionnaire. It is assured that this study is purely for academic purpose only and that your identify will be kept confidential. Hence do not hesitate to provide honest and accurate response. The answered questionnaire may please be returned to Shri. K. Abdul Samad using the enclosed stamped envelope at an early date.

With regards

Yours sincerely
sd/-

N.P. Kumari Sushama

PART I

BACKGROUND INFORMATION

1. a) Name :
   b) Sex : Male / Female
   c) Official address :

   d) Age (Completed years) :

2. Educational status

   Please put tick (✓) mark in your highest academic qualification from the items given below.

   a) Diploma :
   b) Bachelors degree :
   c) Masters degree :
   d) Doctors degree :

3. Rural / Urban background

   From the items given below please tick (✓) the one appropriate to you regarding the location of your native place.

   a) Panchayat area :
   b) Municipal area :
   c) Corporation area :

4. Training received

Sl. No.	Nature of training	Duration (in weeks)	Year of training

5. Job Experience (Service)

a) Total years in Department of Agriculture :
b) Total years in other related organizations :
c) Total years of service (a + b) :
d) Total service in Trivandrum district :

6. Cosmopoliteness
Please tick (✓) the appropriate one

a) Your frequency of visiting the nearest town/city

Twice or more a week
Once a week
Once a fortnight
Once a month
Very rarely
Never

b) Purpose of visit

All visits for official purpose
Some visits for official purpose
Personal purpose / Domestic purpose
Entertainment purpose
Others

7. Exposure to Internet and Information Technology
Please tick (✓) the appropriate one

To what extent do you seek the support of Internet and Information Technology to develop your skills in your profession

Always
Frequently
Sometimes
Never

8. Entrepreneurial behaviour

Please indicate your extent of agreement or disagreement to the following statements by marking tick (✓) in the appropriate columns

Sl.No.	Statements	SA	A	UD	DA	SDA
1.	I am hesitant about starting / running an enterprise					
2.	I will start an enterprise only if somebody prompts me					
3.	I will be willing to join a training course which would help me to start an enterprise					
4.	I am eager to exploit any opportunity to start a new enterprise					
5.	I am willing to try an activity which is income generating					

9. Innovation proness

Tick (✓) one item each in the three sets of statements which is most suiting to you and one is each set which is least suiting to you

Sl. No.	Progressiveness	Most suitable	Least suitable
A.	1. Eventhough I gain knowledge about modern techniques in crop selection and management, I won't adopt them soon in my profession - (1) 2. I want to try the modern techniques in crop selection and management soon after I gain knowledge about it - (3) 3. It is better to wait for some time and think more about adopting the new techniques in crop selection and management - (2)		

Sl. No.	Progressiveness	Most suitable	Least suitable
B.	1. I have tried all the techniques for crop selection and management in my profession - (3) 2. I will try an innovative technique only after observing the experience of others - (2) 3. In my opinion traditional system of crop selection and management is better than the modern techniques - (1)		
C.	1. I am very cautious about trying the new techniques of crop selection and management in my profession - (2) 2. There is no need to deviate from the methods of crop selection and management followed by our ancestors - (1) 3. Eventhough some new techniques of crop selection and management are proven as failure in field, I like to try them if they are good for sustainable agriculture - (3)		

10. Self confidence

Please indicate your degree of agreement / disagreement to the following items by putting a tick (✓) mark in appropriate columns (SA - Strongly agree; A - Agree; UD - Undecided; DA - Disagree; SDA - Strongly Disagree)

Sl. No.	Statements	Response pattern				
		SA	A	UD	DA	SDA
1.	I feel no obstacle can stop me from achieving final goal in my profession					
2.	I am generally confident of my own ability in my profession					
3.	I am bothered by inferiority feelings					

Sl. No.	Statements	Response pattern				
		SA	A	UD	DA	SDA
4.	I do not have initiative					
5.	I usually work out things for myself rather than get someone to show me the skills in my profession					
6.	I get discouraged easily					
7.	Life is a strain for me in much of the time					
8.	I find myself working about something or the other always					

11. Scientific orientation

Please indicate your agreement / disagreement with the statements using a tick (✓) mark in the appropriate columns (SA - Strongly agree; A - Agree; UN - Undecided; DA - Disagree; SDA - Strongly disagree)

Sl. No.	Statements	SA	A	UD	DA	SDA
1.	New scientific methods of crop selection give better results to farmers than old methods					
2.	The way of crop selection by our forefathers is the best way to farm today					
3.	Even an Agricultural Officer with lot of experience should use the latest scientific methods in crop selection and management					
4.	A good Agricultural Officer experiments with new scientific ideas in crop selection and management					
5.	Though it takes time for an Agricultural Officer to learn the new scientific methods in crop selection, it is worth the efforts taken					
6.	Traditional methods in crop selection and management have to be changed in order to achieve sustainable agriculture					

12. Achievement motivation

Please indicate your degree of agreement/disagreement to the following statements by putting a tick (✓) mark in the appropriate columns (SA - Strongly agree; A - agree; UN - undecided; DA - disagree; SDA - Strongly disagree)

Sl. No.	Statements	Response pattern				
		SA	A	UD	DA	SDA
1.	One should enjoy work as much as play					
2.	One should work like a slave at everything one undertakes until he is satisfied with the result					
3.	One should succeed in his occupation even if one has been neglectful of his family					
4.	One should have determination and driving ambition to achieve certain things in life even if these qualities make one unpopular					
5.	Work should come first even if one cannot get rest					
6.	Even when ones own interests are in danger he should concentrate on his job and forget the obligations to others					
7.	One should set difficult goals for oneself and try to reach them					

13. Attitude towards profession

Please indicate your degree of agreement/disagreement to the following statements by putting a tick (✓) mark in the appropriate columns (SA - Strongly agree; A - agree; UN - undecided; DA - disagree; SDA - Strongly disagree)

Sl. No.	Statements	Response pattern				
		SA	A	UD	DA	SDA
1.	I hate my profession because it requires working in rural areas					
2.	Extension profession offers little opportunity to get acquainted with all kinds of people					
3.	Agricultural officers can act as an effective force in bringing about Agricultural development					
4.	Extension personnel have very little to contribute towards National development					
5.	An Agricultural Officer can contribute a lot for agricultural development					
6.	Extension job offers sufficient opportunity for development of leadership ability					
7.	Extension profession is satisfying for me					
8.	Honestly I wish I had not become an Agricultural Officer					
9.	Professional standards of Extension work is far inferior to their professions					
10.	An Agricultural Officer has ample opportunity to display his initiatives					

14. Job satisfaction

Please indicate your degree of satisfaction / dissatisfaction with regard to the following items related to your job by putting a tick (✓) mark in the appropriate columns

Sl. No.	Statements	Very much satisfied	Satisfied	Dissatisfied
	HOW MUCH SATISFIED YOU ARE :			
1.	With the flexibility given by superiors to do your job well			
2.	With the working facilities that you have in your Department			
3.	With the opportunities provided in your job to utilize your personal abilities			
4.	When you consider the expectations you had when you took up this job			
5.	With the work you are doing as Agricultural Officer			
6.	With the job authority delegated to you in order to do your job			
7.	With the recognition given to your work by the people of your area			
8.	With the recognition that you are getting from your collegues			
9.	With the promotional opportunities that you have in the present job			

Sl. No.	Statements	Very much satisfied	Satisfied	Dissatisfied
10.	With your present salary in commensurate with your work and position with the job			
11.	About the rewards and incentives provided in your job by the Department			
12.	With the recognition people are giving to your job when compared with other similar job			
13.	With the security you have with your present job			
14.	With the relation you have with your co-workers			
15.	With the relations you have with your superiors in your Department			
16.	With regard to technical supervision received from your superiors			
17.	With the policies and practices of the department in relation to your work			
18.	With regard to the challenges in your job and your capability			

15. Job involvement

Please indicate your response by putting a tick (✓) mark in the appropriate column against each statement

Sl. No.	Statements	Strongly agree	Agree	Disagree
1.	I shall stay overtime to finish a job even if I am not paid for it			
2.	I can measure a person pretty well by how good a job he/she does			
3.	The major satisfaction in my life comes from my job			
4.	For me day time at work really go off quickly			
5.	I usually go for work a little early to get the things ready			
6.	The most important things that happen to me involve my work			
7.	Sometimes I keep myself awake at night, planning the next days work			
8.	I am really a perfectionist about my work			
9.	I felt distressed when I fail at something connected with my work			
10.	Other activities are more important for me than my work			

Sl. No.	Statements	Strongly agree	Agree	Disagree
11.	The job is my happiness			
12.	I would keep working late even if I do not get any monetary benefits			
13.	Quite often, I feel like staying at home instead of going for work			
14.	To me, my work is only a minor aspect of my life			
15.	I am very much dedicated in my work			
16.	I avoid taking over burden and responsibilities in my work			
17.	I used to be more ambitions about my work than I am at present			
18.	My life is more important than my work			
19.	I used to care more about my work, but now other things are important to me			
20.	Sometimes, I would like to blame myself for the mistakes I make in my life			

16. Organizational climate

Please indicate your response about the items given below by putting tick (✓) mark in the most appropriate alternative to each items (A - Agree; SWA - Some what agree; DA - Disagree)

Sl. No.	Items	A	SWA	DA
	DO YOU AGREE THAT ?			
1.	In the Department of Agriculture, there are many rules and practices the Agricultural Officer have to strictly adhere to, rather than able to do your work as to see fit.			
2.	Agricultural officer can make decisions and solve problems without checking with superiors at each step of the work			
3.	The Department of Agriculture sets challenging goals for itself, communicates this goal commitments to its staff and emphasises the quality performance and outstanding production			
4.	The Department of Agriculture recognizes and rewards for good work of the staff members rather than ignoring, criticizing or punishing when something goes wrong			
5.	Things are well organised and goals are clearly defined in the Department rather than being disorderly or confused			
6.	Friendliness, interpersonal trust and mutual support are very much prevalent in the Department			
7.	As needs for leadership arise, members feel free to take leadership roles and are rewarded for successful leadership			

PART II

A. Awareness on land evaluation for sustainable agriculture development

Following are some of the statements related to land evaluation for sustainable agriculture development, please tick (✓) the answer which you think is correct.

1. The principal objective of land evaluation is to select the optimum land use for each defined land unit.

   Yes / No

2. The first attempt of land evaluation was carried out in Russia for taxation purpose

   Yes / No

3. Land evaluation for agriculture development does not need a multi-disciplinary approach

   Yes / No

4. Land evaluation does not involve comparison of more than one kind of use

   Yes / No

5. There are three types of evaluation namely qualitative, quantitative and economic

   Yes / No

6. Land evaluation for agriculture development can be carried out at reconnaissance, semi-detailed or detailed level

   Yes / No

7. Land evaluation for agriculture development involves execution and interpretation of basic surveys of climate, soil and vegetation

   Yes / No

8. Land evaluation for agriculture development is always attempted in terms of only the physical parameters of the area concerned

   Yes / No

9. The concept of integrated land evaluation was first introduced by the U.S. Department of Agriculture

   Yes / No

10. As per the FAO frame work of land evaluation, there are eight crop suitability classes

    Yes / No

11. Remote sensing technology can be used as an effective tool for land evaluation

    Yes / No

12. Land suitability is a four category system with orders, classes, sub-classes and units

    Yes / No

13. 'Land capability classification' method is better than 'Land suitability' method for optimum crop recommendations

    Yes / No

14. Effective soil depth is a very important parameter for land quality assessment

    Yes / No

15. The FAO 'Factor rating classes' for land use is defined only in terms of the inputs needed

    Yes / No

B. Knowledge on land evaluation for sustainable agriculture development

Below are given certain items to assess your knowledge on land evaluatio for sustainable agriculture. Please tick (✓) the appropriate ones.

1. Land evaluation needs information on

(a) land (b) land use
(c) economics (d) all the three

2. The cat ion exchange capacity (CEC) of organic soils will be

(a) low (b) very low
(c) medium (d) high

3. Pepper can be cultivated upto an altitude of

(a) 500 m above MSL (b) 1000 m above MSL
(c) 1500 m above MSL (d) 2000 m above MSL

4. How many land classes are there in 'land capability classification'

(a) four (b) six
(c) eight (d) ten

5. The best suited soil texture for paddy crop is

(a) sandy (b) sandy loam
(c) silty clay (d) gravelly clay loam

6. Saline soils have exchangeable sodium percentage

(a) < 15 (b) > 15
(c) > 25 (d) < 10

7. Which of the following land capability class is best suited for agriculture

(a) class II land (b) class VII land
(c) class X land (d) none

8. Growing two or more crops in sequence on the same field per year is termed as

   (a) relay cropping (b) crop rotation
   (c) sequential cropping (d) multiple cropping

9. An area of land with climate, land forms, soil and vegetation characteristics which for all practical purposes are considered uniform is termed as

   (a) land system (b) land facet
   (c) land element (d) land use unit

10. Which of the following is best to differentiate between major climatic regions for land evaluation

    (a) altitude (b) temperature regime
    (c) maximum temperature (d) minimum temperature

11. Land capability classification is based on

    (a) agro-climatic situation
    (b) potentiality of land
    (c) permanent physical limitations
    (d) topography of the land

12. The number of crops harvested in relation to the years in cropping cycle is termed as

    (a) cropping duration
    (b) cropping intensity
    (c) cultivation factor
    (d) cropping index

13. A land with 'land irrigability' sub class '6' is

    (a) good for irrigation
    (b) unsuitable for irrigation
    (c) marginally suitable for irrigation
    (d) moderately suitable for irrigation

C. Attitude towards land evaluation for crop suitability

Please indicate your extent of agreement / disagreement to the following statements by putting tick mark (✓) in the appropriate column (SA - strongly agree; A - agree; UD - undecided; DA - disagree; SDA - strongly disagree)

Sl.No.	Statements	SA	A	UD	DA	SDA
1.	Land evaluation is not a must for crop suitability decision					
2.	Land evaluation for crop management ensures preservation of the environment					
3.	Land evaluation for crop suitability will bring out a new out look in agriculture development					
4.	Agricultural development activities must be implemented only after land evaluation					
5.	Land evaluation for crop suitability is a pre-requisite for watershed management					
6.	The effort spent on land evaluation for crop suitability is not worth the profit obtained					
7.	Land evaluation for crop suitability is the only hope for feeding the growing population					
8.	There is nothing new in land evaluation for crop suitability than the age old practice of crop selection by farmers					

Sl.No.	Statements	SA	A	UD	DA	SDA
9.	Land evaluation procedures for crop suitability are very difficult to understand					
10.	Land evaluation for crop suitability lacks flexibility for deciding the crops to be grown in a locality					
11.	Land evaluation for crop suitability is not a pragmatic concept to practice in the field					
12.	Extension personnel feel confident in crop suitability recommendations developed through land evaluation					
13.	As land evaluation involve scientific assessment, it is beyond the reach of farmers					
14.	Land evaluation alone gives the fitness of a given piece of land for a definite use					
15.	Land evaluation can alone help to improve the farmers competency in crop management					

Appendix - VI

Critical values (t) of items for attitude scale construction and their ranks as per 't' values for positive and negative statements

Item Nos.	't' value	Rank of (+) ve statements	Rank of (-) ve statements	Remarks
1	3.21	22		
2	4.34	13		
3	5.03	9		
4	1.39	27		
5	15.55		1	Selected
6	4.93	10		
7	2.18	25		
8	9.25	2		Selected
9	4.93	11		
10	0.62	30		
11	1.59		12	
12	0.77	29		
13	3.54	18		
14	6.82	4		Selected
15	5.24	7		Selected
16	8.40	3		Selected
17	0.80		14	
18	2.30	24		
19	3.73	14		
20	3.45	19		
21	3.57	17		
22	4.55		7	Selected
23	3.27	21		
24	9.45	1		Selected
25	1.15	28		
26	4.80		5	Selected
27	3.33	20		
28	3.21	23		
29	3.52		10	
30	4.15		8	
31	4.64		6	Selected
32	1.95	26		
33	5.00		4	Selected
34	6.23		2	Selected
35	5.50	6		Selected
36	3.74		9	
37	3.57	16		
38	6.03		3	Selected
39	3.68	15		
40	0.96		13	
41	6.42	5		Selected
42	2.07		11	
43	4.35	12		
44	5.13	8		Selected

Appendix - VII

Crop suitability standards fixed for major crops for the study

Name of Crop : **Arecanut**

Sl. No.	Bio-physical factors for land evaluation	Suitability class, Degree of limitation and suitability rating		
		S_1	S_2	S_3
1	Slope (%)	0-8	8-15	8-15
2	Rainfall (mm)	2000-3000	1500-2000	1000-1500
3	Physiography	Valley, Foot slope	Foot slope, Side slope	Side slope
4	Soil depth (cm)	> 150	150-100	150-100
5	Soil texture	f, $\underline{f}$, $\underline{d}$	$\underline{f}$, $\underline{d}$, l	h, c, $\underline{l}$
6	Soil drainage	d_2	d_2	d_2, d_3
7	Erosion	e_1	e_2	e_2
8	Temperature (°C)	25-35	25-35	15-25
9	Elevation (m)	0-250	250-500	500-1000
10	Presence of rocks / gravels / stones (%)	< 3	3-15	3-15
11	Soil pH	5.5-6.5	6.0-7.0	7.0-7.5
12	Ground water	Good	Moderate	Moderate
13	Major nutrients (N:P:K)	0.60:8.7:107	--	--

Soil textures
f - clay loam
$\underline{f}$ - gravelly clay loam
l - sandy clay
c - sandy loam
$\underline{d}$ - gravelly loam
h - sandy clay loam
$\underline{l}$ - gravelly sandy clay loam

Soil drainage
d_1 - excessively drained
d_2 - well drained
d_3 - moderately well drained
d_4 - imperfectly drained
d_5 - poorly drained

Erosion e_1 - slight e_2 - moderate e_3 - severe e_4 - very severe

Major nutrients Standards fixed for S_1 only. It was fixed on the basis of the existing crop stand in the watershed area.

Name of Crop : **Banana**

Sl. No.	Bio-physical factors for land evaluation	Suitability class, Degree of limitation and suitability rating		
		S_1	S_2	S_3
1	Slope (%)	0-8	8-15	15-30
2	Rainfall (mm)	1500-2500	1000-1500	500-1000
3	Physiography	Valley, foot slope	Foot slope, side slope	Side slope
4	Soil depth (cm)	> 150	75-150	50-75
5	Soil texture	f, $\underline{d}$, $\underline{f}$	f, $\underline{d}$, $\underline{f}$, h, l	h, $\underline{l}$, c
6	Soil drainage	d_2	d_2, d_3	d_4, d_5
7	Erosion	e_1	e_2	e_2
8	Temperature (°C)	22-30	30-35	20-22
9	Elevation (m)	< 50	50-500	500-1000
10	Presence of rocks / gravels / stones (%)	0-15	15-40	40-55
11	Soil pH	5.5-7.0	4.5-5.5	7.5-8.5
12	Ground water	Good	Good, Moderate	Moderate
13	Major nutrients (N:P:K)	0.14:19:320	--	--

Soil textures
f - clay loam; $\underline{f}$ - gravelly clay loam
l - sandy clay; c - sandy loam
$\underline{d}$ - gravelly loam; h - sandy clay loam
$\underline{l}$ - gravelly sandy clay loam

Soil drainage
d_1 - excessively drained; d_2 - well drained
d_3 - moderately well drained; d_4 - imperfectly drained
d_5 - poorly drained

Erosion e_1 - slight; e_2 - moderate; e_3 - severe; e_4 - very severe

Major nutrients Standards fixed for S_1 only. It was fixed on the basis of the existing crop stand in the watershed area.

Name of Crop : **Cashew**

Sl. No.	Bio-physical factors for land evaluation	Suitability class, Degree of limitation and suitability rating		
		S_1	S_2	S_3
1	Slope (%)	0-8	8-15	15-50
2	Rainfall (mm)	1500-2500	2500-3500	500-1500
3	Physiography	Foot slopes, Side slopes	Side slopes, Submit	Side slopes, Submit
4	Soil depth (cm)	> 100	50-100	25-50
5	Soil texture	$\underline{f}$, $\underline{d}$, c, f	l, h, $\underline{l}$	l, h, $\underline{l}$
6	Soil drainage	d_2, d_3	d_3, d_1	d_3, d_1
7	Erosion	e_1, e_2	e_2, e_3	e_3, e_4
8	Temperature (°C)	25-35	20-25	20-25
9	Elevation (m)	0-250	250-500	500-700
10	Presence of rocks / gravels / stones (%)	0-15	15-40	40-75
11	Soil pH	5.5-7.0	4.5-5.5	7.0-8.5
12	Ground water	Moderate	Moderate, Poor	Poor, Very Poor
13	Major nutrients (N:P:K)	0.22:>50:150	--	--

Soil textures
f - clay loam; $\underline{f}$ - gravelly clay loam
l - sandy clay; c - sandy loam
$\underline{d}$ - gravelly loam; h - sandy clay loam
$\underline{l}$ - gravelly sandy clay loam

Soil drainage
d_1 - excessively drained; d_2 - well drained
d_3 - moderately well drained; d_4 - imperfectly drained
d_5 - poorly drained

Erosion
e_1 - slight; e_2 - moderate; e_3 - severe; e_4 - very severe

Major nutrients Standards fixed for S_1 only. It was fixed on the basis of the existing crop stand in the watershed area.

Name of Crop : **Cassava (Tapioca)**

Sl. No.	Bio-physical factors for land evaluation	Suitability class, Degree of limitation and suitability rating		
		S_1	S_2	S_3
1	Slope (%)	< 3	3-15	15-35
2	Rainfall (mm)	1500-2000	2500-3000	750-1000
3	Physiography	Valley, foot slope	Side slope	Side slope, submit
4	Soil depth (cm)	> 100	> 75	> 50
5	Soil texture	$\underline{d}$, $\underline{f}$	c, f, $\underline{l}$, l	$\underline{l}$, l
6	Soil drainage	d_2	d_2,d_3	d_4,d_1
7	Erosion	e_1	e_2	e_2
8	Temperature (°C)	25-30	30-35	35-40
9	Elevation (m)	5-500	500-750	750-1000
10	Presence of rocks / gravels / stones (%)	< 3	3-15	15-40
11	Soil pH	5.1-7.0	5.1-7.0	4.5-5.0
12	Ground water	Good, Moderate	Moderate	Moderate
13	Major nutrients (N:P:K)	0.14:19:20	--	--

Soil textures
f - clay loam; $\underline{f}$ - gravelly clay loam
l - sandy clay; c - sandy loam
$\underline{d}$ - gravelly loam; h - sandy clay loam
$\underline{l}$ - gravelly sandy clay loam

Soil drainage
d_1 - excessively drained; d_2 - well drained
d_3 - moderately well drained; d_4 - imperfectly drained
d_5 - poorly drained

Erosion e_1 - slight e_2 - moderate e_3 - severe e_4 - very severe

Major nutrients Standards fixed for S_1 only. It was fixed on the basis of the existing crop stand in the watershed area.

Name of Crop : **Clove**

Sl. No.	Bio-physical factors for land evaluation	Suitability class, Degree of limitation and suitability rating		
		S_1	S_2	S_3
1	Slope (%)	0-8	8-15	15-25
2	Rainfall (mm)	2000-2500	1500-2000	1500-2000
3	Physiography	Foot slopes	Side slopes	Side slopes
4	Soil depth (cm)	> 200	150-200	100-150
5	Soil texture	f, l	$\underline{f}$, $\underline{d}$	c, h, $\underline{l}$
6	Soil drainage	d_2	d_2	d_3, d_1
7	Erosion	e_1	e_2	e_2
8	Temperature (°C)	20-25	25-30	15-20
9	Elevation (m)	300-750	50-300	< 50
10	Presence of rocks / gravels / stones (%)	< 3	3-15	3-15
11	Soil pH	5.0-6.0	4.5-5.0	4.5-5.0
12	Ground water	Good, Moderate	Moderate	Moderate
13	Major nutrients (N:P:K)	0.20:>60:208	--	--

Soil textures
f - clay loam; $\underline{f}$ - gravelly clay loam
l - sandy clay; c - sandy loam
$\underline{d}$ - gravelly loam; h - sandy clay loam
$\underline{l}$ - gravelly sandy clay loam

Soil drainage
d_1 - excessively drained; d_2 - well drained
d_3 - moderately well drained; d_4 - imperfectly drained
d_5 - poorly drained

Erosion e_1 - slight e_2 - moderate e_3 - severe e_4 - very severe

Major nutrients Standards fixed for S_1 only. It was fixed on the basis of the existing crop stand in the watershed area.

Name of Crop : **Cocoa**

Sl. No.	Bio-physical factors for land evaluation	Suitability class, Degree of limitation and suitability rating		
		S_1	S_2	S_3
1	Slope (%)	0-8	8-15	15-35
2	Rainfall (mm)	1600-2500	1400-1600	2500-3500
3	Physiography	Foot slopes	Side slopes	Side slopes
4	Soil depth (cm)	> 150	100-150	75-100
5	Soil texture	f, $\underline{f}$, $\underline{d}$	$\underline{f}$, $\underline{d}$, $\underline{l}$	c, h
6	Soil drainage	d_2	d_2, d_3	d_3, d_1
7	Erosion	e_1	e_2	e_2, e_3
8	Temperature (°C)	20-30	30-35	15-20
9	Elevation (m)	0-500	500-750	750-900
10	Presence of rocks / gravels / stones (%)	0-15	15-40	40-55
11	Soil pH	6.0-7.0	5.0-6.0	7.0-8.2
12	Ground water	Moderate	Moderate	Moderate
13	Major nutrients (N:P:K)	0.20:21:416	--	--

Soil textures
f - clay loam; $\underline{f}$ - gravelly clay loam
l - sandy clay; c - sandy loam
$\underline{d}$ - gravelly loam; h - sandy clay loam
$\underline{l}$ - gravelly sandy clay loam

Soil drainage
d_1 - excessively drained; d_2 - well drained
d_3 - moderately well drained; d_4 - imperfectly drained
d_5 - poorly drained

Erosion e_1 - slight e_2 - moderate e_3 - severe e_4 - very severe

Major nutrients Standards fixed for S_1 only. It was fixed on the basis of the existing crop stand in the watershed area.

Name of Crop : **Coconut**

Sl. No.	Bio-physical factors for land evaluation	Suitability class, Degree of limitation and suitability rating		
		S_1	S_2	S_3
1	Slope (%)	0-8	8-16	16-30
2	Rainfall (mm)	> 1600	1250-1600	1000-1250
3	Physiography	Valley, foot slope	Foot slope, side slope	Side slope, submit
4	Soil depth (cm)	> 150	100-150	50-100
5	Soil texture	$\underline{f}$, $\underline{d}$, c	h, $\underline{l}$, c, l	$\underline{l}$, c, f
6	Soil drainage	d_1, d_2	d_2,d_3	d_4
7	Erosion	e_1	e_2	e_2
8	Temperature (°C)	30-35	25-30	20-25
9	Elevation (m)	< 300	300-600	600-1200
10	Presence of rocks / gravels / stones (%)	< 15	15-40	40-75
11	Soil pH	5.5-7.0	4.5-5.5	> 7.0
12	Ground water	Good	Moderate	Moderate
13	Major nutrients (N:P:K)	0.20:>60:208	--	--

Soil textures
- f - clay loam
- l - sandy clay
- $\underline{d}$ - gravelly loam
- $\underline{l}$ - gravelly sandy clay loam
- $\underline{f}$ - gravelly clay loam
- c - sandy loam
- h - sandy clay loam

Soil drainage
- d_1 - excessively drained
- d_3 - moderately well drained
- d_5 - poorly drained
- d_2 - well drained
- d_4 - imperfectly drained

Erosion e_1 - slight e_2 - moderate e_3 - severe e_4 - very severe

Major nutrients Standards fixed for S_1 only. It was fixed on the basis of the existing crop stand in the watershed area.

Name of Crop : **Ginger**

Sl. No.	Bio-physical factors for land evaluation	Suitability class, Degree of limitation and suitability rating		
		S_1	S_2	S_3
1	Slope (%)	0-8	8-15	5-30
2	Rainfall (mm)	1500-2000	1500-1000	1000
3	Physiography	Foot slopes	Side slopes	Side slopes
4	Soil depth (cm)	> 150	100-150	75-100
5	Soil texture	'f' with high humous	$\underline{f}$, l	c, $\underline{d}$
6	Soil drainage	d_2	d_2	d_2, d_3
7	Erosion	e_1	e_2	e_2
8	Temperature (°C)	20-25	25-30	10-15
9	Elevation (m)	100-1000	0-100	1000-1500
10	Presence of rocks / gravels / stones (%)	< 3	3-15	3-15
11	Soil pH	5.0-6.0	4.0-5.0	6.0-7.0
12	Ground water	Moderate	Moderate	Moderate
13	Major nutrients (N:P:K)	0.60:8.7:107	--	--

Soil textures
f - clay loam
l - sandy clay
$\underline{d}$ - gravelly loam
$\underline{l}$ - gravelly sandy clay loam
$\underline{f}$ - gravelly clay loam
c - sandy loam
h - sandy clay loam

Soil drainage
d_1 - excessively drained
d_2 - well drained
d_3 - moderately well drained
d_4 - imperfectly drained
d_5 - poorly drained

Erosion e_1 - slight e_2 - moderate e_3 - severe e_4 - very severe

Major nutrients Standards fixed for S_1 only. It was fixed on the basis of the existing crop stand in the watershed area.

Name of Crop : **Mango**

Sl. No.	Bio-physical factors for land evaluation	Suitability class, Degree of limitation and suitability rating		
		S_1	S_2	S_3
1	Slope (%)	0-8	8-15	15-30
2	Rainfall (mm)	2000-3000	1000-2000	500-1000
3	Physiography	Foot slope, Side slope	Side slope	Side slope, Submit
4	Soil depth (cm)	> 150	75-150	50-75
5	Soil texture	f, $\underline{f}$, c, d	$\underline{f}$, c, $\underline{d}$, h	L, h, $\underline{l}$
6	Soil drainage	d_2	d_2, d_3	d_3, d_1
7	Erosion	e_1, e_2	e_2, e_3	e_2, e_3
8	Temperature (°C)	25-35	18-25	15-18
9	Elevation (m)	< 250	250-500	500-1500
10	Presence of rocks / gravels / stones (%)	0-15	15-40	40-55
11	Soil pH	5.5-7.0	5-5.5	4.5-5
12	Ground water	Moderate	Moderate	Poor
13	Major nutrients (N:P:K)	0.22:50:150	--	--

Soil textures
f - clay loam
$\underline{f}$ - gravelly clay loam
l - sandy clay
c - sandy loam
$\underline{d}$ - gravelly loam
h - sandy clay loam
$\underline{l}$ - gravelly sandy clay loam

Soil drainage
d_1 - excessively drained
d_2 - well drained
d_3 - moderately well drained
d_4 - imperfectly drained
d_5 - poorly drained

Erosion e_1 - slight e_2 - moderate e_3 - severe e_4 - very severe

Major nutrients Standards fixed for S_1 only. It was fixed on the basis of the existing crop stand in the watershed area.

Name of Crop : **Nutmeg**

Sl. No.	Bio-physical factors for land evaluation	Suitability class, Degree of limitation and suitability rating		
		S_1	S_2	S_3
1	Slope (%)	0-8	8-15	15-25
2	Rainfall (mm)	2000-2500	1500-2000	1000-1500
3	Physiography	Foot slope	Side slope	Side slope, Submit
4	Soil depth (cm)	> 200	150-200	100-150
5	Soil texture	f, l	$\underline{f}$, $\underline{d}$	c, h, $\underline{l}$
6	Soil drainage	d_2	d_2	d_3, d_1
7	Erosion	e_1	e_2	e_3
8	Temperature (°C)	25-30	30-35	15-25
9	Elevation (m)	100-500	0-100	500-900
10	Presence of rocks / gravels / stones (%)	0-8	8-15	15-25
11	Soil pH	5.5-6.5	5.0-5.5	5.0-5.5
12	Ground water	Good, Moderate	Moderate	Moderate
13	Major nutrients (N:P:K)	0.20:>60:208	--	--

Soil textures
f - clay loam; $\underline{f}$ - gravelly clay loam
l - sandy clay; c - sandy loam
$\underline{d}$ - gravelly loam; h - sandy clay loam
$\underline{l}$ - gravelly sandy clay loam

Soil drainage
d_1 - excessively drained; d_2 - well drained
d_3 - moderately well drained; d_4 - imperfectly drained
d_5 - poorly drained

Erosion e_1 - slight e_2 - moderate e_3 - severe e_4 - very severe

Major nutrients Standards fixed for S_1 only. It was fixed on the basis of the existing crop stand in the watershed area.

Name of Crop : **Paddy**

Sl. No.	Bio-physical factors for land evaluation	Suitability class, Degree of limitation and suitability rating		
		S_1	S_2	S_3
1	Slope (%)	0-3	3-8	8-15
2	Rainfall (mm)	2000-2500	1500-2000	1000-1500
3	Physiography	Valley	Valley	Valley, foot slope
4	Soil depth (cm)	> 150	75-150	50-75
5	Soil texture	f, l	l, h	h, $\underline{l}$, c
6	Soil drainage	d_5, d_4	d_5, d_4	D_4
7	Erosion	e_1	e_1	E_1
8	Temperature (°C)	25-30	30-35	35-40
9	Elevation (m)	< 300	300-600	600-1800
10	Presence of rocks / gravels / stones (%)	< 3	3-15	3-15
11	Soil pH	5.5-7.0	4.5-7.0	7.0-8.5
12	Ground water	Good	Good	Good
13	Major nutrients (N:P:K)	0.60:8.7:109	--	--

Soil textures
f - clay loam; $\underline{f}$ - gravelly clay loam
l - sandy clay; c - sandy loam
$\underline{d}$ - gravelly loam; h - sandy clay loam
$\underline{l}$ - gravelly sandy clay loam

Soil drainage
d_1 - excessively drained; d_2 - well drained
d_3 - moderately well drained; d_4 - imperfectly drained
d_5 - poorly drained

Erosion e_1 - slight e_2 - moderate e_3 - severe e_4 - very severe

Major nutrients Standards fixed for S_1 only. It was fixed on the basis of the existing crop stand in the watershed area.

Name of Crop : **Pepper**

Sl. No.	Bio-physical factors for land evaluation	Suitability class, Degree of limitation and suitability rating		
		S_1	S_2	S_3
1	Slope (%)	0-8	8-15	15-25
2	Rainfall (mm)	2000-2500	1500-2000	1250-1500
3	Physiography	Foot slope	Side slope	Side slope
4	Soil depth (cm)	> 150	100-150	50-100
5	Soil texture	$\underline{d}$, $\underline{f}$	c, f, h	h, c, $\underline{l}$
6	Soil drainage	d_2	d_2	d_2, d_3
7	Erosion	e_1	e_2	e_2
8	Temperature (°C)	20-30	30-35	15-20
9	Elevation (m)	< 250	250-750	750-1500
10	Presence of rocks / gravels / stones (%)	< 3	< 3	3-15
11	Soil pH	5-6.5	6.5-7.0	6.5-7.0
12	Ground water	Moderate	Moderate	Moderate
13	Major nutrients (N:P:K)	0.20:>60:208	--	--

Soil textures
f - clay loam; $\underline{f}$ - gravelly clay loam
l - sandy clay; c - sandy loam
$\underline{d}$ - gravelly loam; h - sandy clay loam
$\underline{l}$ - gravelly sandy clay loam

Soil drainage
d_1 - excessively drained; d_2 - well drained
d_3 - moderately well drained; d_4 - imperfectly drained
d_5 - poorly drained

Erosion e_1 - slight e_2 - moderate e_3 - severe e_4 - very severe

Major nutrients Standards fixed for S_1 only. It was fixed on the basis of the existing crop stand in the watershed area.

Name of Crop : **Pineapple**

Sl. No.	Bio-physical factors for land evaluation	Suitability class, Degree of limitation and suitability rating		
		S_1	S_2	S_3
1	Slope (%)	3-8	8-15	15-30
2	Rainfall (mm)	1000-1500	1500-2000	600-1000 & 2000-2500
3	Physiography	Foot slope, Side slope	Side slope	Side slope, Submit
4	Soil depth (cm)	> 150	75-150	50-75
5	Soil texture	$\underline{f}$, $\underline{d}$	f, h, $\underline{l}$	f, h, l, c
6	Soil drainage	d_2	d_3, d_1	d_4
7	Erosion	e_1	e_2	e_2, e_3
8	Temperature (°C)	20-30	30-35	15-25
9	Elevation (m)	5-250	250-500	500-900
10	Presence of rocks / gravels / stones (%)	0-15	15-40	40-55
11	Soil pH	5-6.5	6.5-7.0	4.5-5
12	Ground water potential	Good	Moderate	Moderate
13	Major nutrients (N:P:K)	0.24:>60:95	--	--

Soil textures
f - clay loam; $\underline{f}$ - gravelly clay loam
l - sandy clay; c - sandy loam
$\underline{d}$ - gravelly loam; h - sandy clay loam
$\underline{l}$ - gravelly sandy clay loam

Soil drainage
d_1 - excessively drained; d_2 - well drained
d_3 - moderately well drained; d_4 - imperfectly drained
d_5 - poorly drained

Erosion e_1 - slight e_2 - moderate e_3 - severe e_4 - very severe

Major nutrients Standards fixed for S_1 only. It was fixed on the basis of the existing crop stand in the watershed area.

Name of Crop : **Pulses**

Sl. No.	Bio-physical factors for land evaluation	Suitability class, Degree of limitation and suitability rating		
		S_1	S_2	S_3
1	Slope (%)	0-8	8-15	8-15
2	Rainfall (mm)	700-1500	1500-3000	1500-3000
3	Physiography	Valley, Foot slope	Foot slope, Side slope	Side slope, Submit
4	Soil depth (cm)	> 100	75-100	50-75
5	Soil texture	f	$\underline{f}$, $\underline{d}$, c	l, h, c
6	Soil drainage	d_2	d_3	d_3
7	Erosion	e_1	e_2	e_2
8	Temperature (°C)	25-35	20-25	16-20
9	Elevation (m)	< 80	80-200	200-500
10	Presence of rocks / gravels / stones (%)	0-8	8-15	15-30
11	Soil pH	6.0-7.0	5.0-6.0	7.0-8.5
12	Ground water	Good	Moderate	Moderate
13	Major nutrients (N:P:K)	0.14:19:320	--	--

Soil textures
f - clay loam
$\underline{f}$ - gravelly clay loam
l - sandy clay
c - sandy loam
$\underline{d}$ - gravelly loam
h - sandy clay loam
$\underline{l}$ - gravelly sandy clay loam

Soil drainage
d_1 - excessively drained
d_2 - well drained
d_3 - moderately well drained
d_4 - imperfectly drained
d_5 - poorly drained

Erosion e_1 - slight e_2 - moderate e_3 - severe e_4 - very severe

Major nutrients Standards fixed for S_1 only. It was fixed on the basis of the existing crop stand in the watershed area.

Name of Crop : **Rubber**

Sl. No.	Bio-physical factors for land evaluation	Suitability class, Degree of limitation and suitability rating		
		S_1	S_2	S_3
1	Slope (%)	3-15	15-35	35-50
2	Rainfall (mm)	2000-2250	1700-2000	1500-1700
3	Physiography	Side slope	Side slope, submit	Side slope, submit
4	Soil depth (cm)	> 150	100-150	100-150
5	Soil texture	$\underline{f}$, $\underline{d}$	f, c	f, $\underline{l}$, l
6	Soil drainage	d_2	d_2, d_3	d_3
7	Erosion	e_1	e_2	e_2, e_3
8	Temperature (°C)	21-35	21-35	35-40
9	Elevation (m)	50-300	300-500	500-1200
10	Presence of rocks / gravels / stones (%)	< 5	5-15	15-40
11	Soil pH	5-6.5	5-6.5	6.5-7.0
12	Ground water	Moderate	Moderate	Poor
13	Major nutrients (N:P:K)	0.22:12:270	--	--

Soil textures
f - clay loam; $\underline{f}$ - gravelly clay loam
l - sandy clay; c - sandy loam
$\underline{d}$ - gravelly loam; h - sandy clay loam
$\underline{l}$ - gravelly sandy clay loam

Soil drainage
d_1 - excessively drained; d_2 - well drained
d_3 - moderately well drained; d_4 - imperfectly drained
d_5 - poorly drained

Erosion e_1 - slight e_2 - moderate e_3 - severe e_4 - very severe

Major nutrients Standards fixed for S_1 only. It was fixed on the basis of the existing crop stand in the watershed area.

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Name of Crop : **Sapota**

Sl. No.	Bio-physical factors for land evaluation	Suitability class, Degree of limitation and suitability rating		
		S_1	S_2	S_3
1	Slope (%)	3-8	8-15	15-25
2	Rainfall (mm)	2500-3500	2000-2500	1500-2000
3	Physiography	Side slopes	Side slopes	Side slopes
4	Soil depth (cm)	> 200	150-200	150-100
5	Soil texture	f, $\underline{f}$, $\underline{d}$	$\underline{f}$, c, $\underline{d}$, h, f	f, $\underline{f}$, c, $\underline{d}$, h, l
6	Soil drainage	d_2	d_3	d_3
7	Erosion	e_1	e_2	e_2
8	Temperature (°C)	20-30	30-35	35-40
9	Elevation (m)	10-300	300-500	500-1500
10	Presence of rocks / gravels / stones (%)	< 10	10-15	10-40
11	Soil pH	5.5-6.5	6.5-7.0	5.0-5.5
12	Ground water	Moderate	Moderate	Poor
13	Major nutrients (N:P:K)	0.20:21:416	--	--

Soil textures
- f - clay loam
- $\underline{f}$ - gravelly clay loam
- l - sandy clay
- c - sandy loam
- $\underline{d}$ - gravelly loam
- h - sandy clay loam
- $\underline{l}$ - gravelly sandy clay loam

Soil drainage
- d_1 - excessively drained
- d_2 - well drained
- d_3 - moderately well drained
- d_4 - imperfectly drained
- d_5 - poorly drained

Erosion e_1 - slight e_2 - moderate e_3 - severe e_4 - very severe

Major nutrients Standards fixed for S_1 only. It was fixed on the basis of the existing crop stand in the watershed area.

Name of Crop : **Vegetables (tropical)**

Sl. No.	Bio-physical factors for land evaluation	Suitability class, Degree of limitation and suitability rating		
		S_1	S_2	S_3
1	Slope (%)	0-8	8-15	15-25
2	Rainfall (mm)	1500-2500	2500-3000	1000-1500
3	Physiography	Valley, Foot slope	Side slope	Side slope
4	Soil depth (cm)	> 100	75-100	50-75
5	Soil texture	f, h	$\underline{f}$, $\underline{d}$, l	c, $\underline{l}$
6	Soil drainage	d_2	d_3, d_4	d_3, d_4
7	Erosion	e_1	e_2	e_2
8	Temperature (°C)	25-35	20-25	15-20
9	Elevation (m)	0-250	250-500	500-1000
10	Presence of rocks / gravels / stones (%)	< 3	3-15	3-15
11	Soil pH	6.0-7.0	5.0-6.0	7.0-8.2
12	Ground water	Good, Moderate	Moderate	Moderate
13	Major nutrients (N:P:K)	0.14:19:320	--	--

Soil textures
f - clay loam; $\underline{f}$ - gravelly clay loam
l - sandy clay; c - sandy loam
$\underline{d}$ - gravelly loam; h - sandy clay loam
$\underline{l}$ - gravelly sandy clay loam

Soil drainage
d_1 - excessively drained; d_2 - well drained
d_3 - moderately well drained; d_4 - imperfectly drained
d_5 - poorly drained

Erosion e_1 - slight e_2 - moderate e_3 - severe e_4 - very severe

Major nutrients Standards fixed for S_1 only. It was fixed on the basis of the existing crop stand in the watershed area.

Appendix – VIII

KERALA AGRICULTURAL UNIVERSITY

Department of Agricultural Extension, College of Agriculture, Vellayani

Proforma for rating the socio-economic factors of land evaluation by the farmers for crop suitability of major crops (use ✓ marks)

Name :   Address :

No	Name of crop	Rating of the socio-economic factors of land evaluation for crop suitability																	
		Economic viability			Economic feasibility			Infrastructural facilities			Market demand			Social acceptability			Farming experience		
		S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3
1	Paddy																		
2	Coconut																		
3	Rubber																		
4	Banana																		
5	Vegetables																		
6	Tapioca																		
7	Cashew																		
8	Arecanut																		
9	Pineapple																		
10	Mango																		
11	Pepper																		
12	Sapota																		
13	Pulses																		
14	Ginger																		
15	Cocoa																		

S_1 - > 80 per cent level S_2 - 40-80 per cent level S_3 - > 80 per cent level

Appendix - IX

KERALA AGRICULTURAL UNIVERSITY

Department of Agricultural Extension, College of Agriculture, Vellayani-695 522

Unstructured Open-ended questions for Focus Group Interview

Group No........ Number of Participants........... Location...............

1. How do you feel about the spatial crop suitability model ?

2. To what extent the spatial crop suitability model can be used for deciding the crops by the farmers of the area ?

3. How can the crop suitability model be used for the sustainable management of the watershed area ?

4. How do you think about the spatial crop suitability model helping the activities of Department of Agriculture ?

5. What do you think best about the spatial crop suitability model ?

6. What are the major constraints you expect in implementing the recommendations of spatial crop suitability model ?

Appendix - X

Code numbers of items judged by 29 judges (except judge No. 3) falling in the first three piles with weightage scores as per the ranking in Q-sort

Judges code nos.	Pile 1*	Pile 2*	Pile 3*
1	30,44,46,55	18,21,53,58,73,77	22,34,35,42,54,59,60,71,76
2	3,7,3,5,1	54,51,12,22,23,26	43,57,11,8,34,46,65,79,56
4	5,39,46,60	27,28,23,22,57,73	54,50,76,1,41,32,31,16,19
5	1,22,16,39	5,26,60,28,37,23	10,19,45,54,48,42,62,20,34
6	49,45,43,56	9,10,23,28,79,30	5,19,37,42,47,27,48,54,73
7	1,22,23,60	48,43,58,53,30,44	16,38,37,28,66,36,68,15,54
8	5,16,10,39	22,57,19,15,26,3	1,41,50,54,36,42,9,74,80
9	39,1,5,16	22,10,19,26,80,15	64,3,9,34,20,48,42,62,54
10	5,39,16,10	1,36,19,46,42,22	26,80,47,48,50,15,54,59,3
11	39,16,10,1	5,38,19,26,32,22	45,36,64,12,73,31,43,80,74
12	19,23,44,45	15,22,27,28,38,74	1,7,10,16,32,37,49,56,79
13	1,39,5,16	10,42,46,36,19,47	48,22,80,26,54,15,50,9,64
14	16,19,32,22	39,45,36,3,1,5	42,80,37,54,34,18,48,57,46
15	1,22,2,23	5,16,39,27,19,28	58,20,48,45,54,73,44,76,78
16	39,1,10,5	16,15,19,26,42,22	3,36,64,48,54,9,43,80,74
17	5,16,39,1	26,10,42,15,19,36	48,54,9,3,22,64,20,53,43
18	1,5,10,42	39,16,48,47,36,19	46,15,54,22,80,26,57,51,3
19	5,16,80,79	3,43,10,48,22,39	63,56,19,1,11,9,74,62,2
20	1,10,5,16	39,19,26,15,36,3	22,42,9,54,48,64,20,53,43
21	3,39,36,43	64,1,5,48,80,16	10,46,26,19,74,50,54,15,22
22	3,80,79,43	16,5,10,48,62,2	63,56,19,1,39,22,11,9,74
23	5,16,39,1	10,19,36,46,42,26	22,47,80,50,48,15,54,59,9
24	1,39,10,16	5,15,19,26,42,46	54,36,3,48,64,9,43,20,53
25	3,39,36,64	1,43,5,48,46,10	16,80,26,19,74,50,54,15,57
26	39,5,16,1	10,43,53,19,36,80	22,48,47,23,15,54,50,28,37
27	5,16,42,39	10,1,50,79,36,32	44,22,15,54,57,27,80,51,60
28	16,39,43,9	56,23,10,28,5,19	79,80,47,42,37,27,48,54,22
29	46,18,21,53	58,55,44,30,73,22	77,42,35,34,31,27,24,12,8
30	39,36,1,43	3,64,5,26,46,10	16,80,48,74,19,50,57,22,15

*Pile nos.	Weightage scores
1	3
2	2
3	1

Appendix - XI

Frequency in rating of socio-economic factors of land evaluation by the farmers for crop suitability of major crops in the watershed area

(n=30)

No	Name of crop	Frequency of respondents																	
		Economic viability			Economic feasibility			Infrastructural facilities			Market demand			Social acceptability			Farming experience		
		S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3
1	Paddy	3	14	13	4	12	14	2	15	13	5	18	7	24	6	-	25	5	-
2	Coconut	7	12	11	5	16	9	3	13	14	10	14	6	26	4	-	24	6	-
3	Rubber	12	18	-	10	18	2	5	14	11	6	22	2	11	15	4	5	13	12
4	Banana	22	8	-	24	6	-	10	15	5	23	7	-	7	18	5	15	13	2
5	Vegetables	4	16	10	1	18	11	7	10	13	2	19	9	11	15	4	8	16	6
6	Tapioca	9	16	5	11	15	4	14	13	3	15	14	1	6	21	3	21	9	-
7	Cashew	7	10	13	4	14	12	6	10	14	9	16	5	2	14	14	4	13	13
8	Arecanut	1	15	14	1	15	14	2	15	13	-	15	15	8	13	9	7	14	9
9	Pineapple	1	12	17	2	13	15	-	10	20	5	12	13	-	7	23	-	17	13
10	Mango	2	10	18	-	8	22	-	19	11	5	12	13	10	15	5	2	11	17
11	Pepper	-	18	12	-	17	13	-	17	13	5	13	12	11	19	-	5	22	3
12	Sapota	-	4	26	-	4	26	-	13	17	-	4	26	-	2	28	-	5	25
13	Pulses	4	17	9	5	20	5	4	21	5	6	11	13	15	11	4	16	14	-
14	Ginger	10	9	11	6	12	12	5	10	15	2	15	13	6	15	9	4	19	7
15	Cocoa	-	5	25	-	2	28	-	2	28	-	3	27	-	7	23	7	19	4

S_1 - > 80 per cent level S_2 – 40-80 per cent level S_3 - < 40 per cent level

DEVELOPMENT OF SPATIAL CROP SUITABILITY MODEL THROUGH PARTICIPATORY AND INTEGRATED LAND EVALUATION FOR SUSTAINABLE AGRICULTURE

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Abstract of the
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ABSTRACT

The study was carried out with the objective of developing a 'spatial crop suitability model' through participatory and integrated land evaluation approach in a selected watershed with diversified agro-ecological situation and to evaluate the response of Agricultural Officers towards land evaluation for sustainable agriculture development. Besides, the utility of the model as perceived by the farmers was also studied.

The locale of the study was Thiruvananthapuram district of Kerala with all the Agricultural Officers working in the district as respondents for studying their response towards land evaluation. A selected watershed area namely 'Aruvipuram watershed' of 3109.12 hectares within Neyyar river basin having diverse agro-ecological situation was identified for developing the spatial crop suitability model and 30 progressive farmers of the selected watershed area was used as respondents for studying the perceived utility of the spatial crop suitability model.

The dependent variables were awareness, knowledge and attitude. The selected 17 profile characteristics of Agricultural Officers formed the independent variables.

The most important biophysical and socio-economic factors of land evaluation for the study were identified using Pusa rank sheet for Q-sort through ranking by selected judges. Primary spatial data base of biophysical factors were generated using secondary data, remote sensing data and ground truth. Participatory land evaluation of biophysical factors were carried out through

Participatory Appraisal of Natural Resources (PANR). Integrated land evaluation was fulfilled by deriving the spatial crop suitability model through Geographic Information System (GIS). With help of the spatial model supported by participatory crop wise land evaluation of socio-economic factors, crop suitability recommendations for the watershed area was arrived at in line with the 'factor rating' method of FAO for crop suitability at S1, S2 and S3 levels (highly suitable, moderately suitable and marginally suitable respectively). Focus group interview was adopted to study the perceived utility of the model by the farmers. The awareness, knowledge and attitude of Agricultural Officers towards land evaluation were studied through a teacher-made test, knowledge test and attitude scale respectively developed for the purpose of the study. Mean, percentage analysis and correlation analysis were the major statistical tools employed.

The study helped in identifying thirteen biophysical factors namely slope, rainfall, physiography, soil depth, soil texture, soil drainage, soil erosion, temperature, elevation, presence of rocks/stones/gravels, soil pH, ground water and major nutrients. The six identified socio-economic factors were economic viability, economic feasibility, infra-structural facilities, market demand, social acceptability and farming experience.

Majority of respondents (Agricultural Officers) were in medium category with respect to their awareness and knowledge on land evaluation. Majority of respondents had favourable attitude towards land evaluation. There existed significant and positive relation between the dependent variables. Also significant positive and negative relationship existed between some independent and dependent variables.

Analysis of biophysical factors of the watershed revealed that the area was suitable for a wide range of humid tropical crops (both perennial and seasonal). Participatory land evaluation of socio-economic factors revealed that the area was unsuitable for four crops namely pineapple, cocoa, mango and sapota.

Integration of the primary spatial database of biophysical factors using GIS (ARC/INFO package) helped in generating the spatial crop suitability model on 1:10,000 scale with 1508 land mapping units (LMUs). The area of LMUs ranged from 0.201 hectares to 37.411 hectares. Crop suitability recommendation with the help of crop suitability model revealed that as per the S1 class the maximum watershed area can be put under coconut and as per both S2 and S3 classes the maximum area is suitable for rubber. The crop suitability recommendations derived through spatial crop suitability model will help for sustainable agriculture development.

With regard to the use of remote sensing technology, while the aerial photos on 1:15000 scale were found to be very useful for micro watershed level studies, IRS (LISS III) satellite images on 1:50,000 scale only partially supported micro level studies due to the limitation of resolution.

As perceived by the farmers, the spatial crop suitability model will help the planners, farmers and officers of the Department of Agriculture in decision making on the right selection of crops and its management for each locality. The content of participatory land evaluation of socio-economic factors will make the model socially acceptability also. As opined by the respondents the major constraints expected for the utility of the model were lack of political will, fluctuation in market price, untimely supply of inputs, lack of irrigation water, high labour charges and vanishing landlord-labourer relationship.