CHAPTER – II

REVIEW OF LITERATURE AND CONCEPTS

2.1 General

To develop clarity and comprehension in any study, it is necessary first to review the various concepts, research methodologies and analytical tools used by researchers in earlier studies. Such an attempt would help the researcher to have better and precise understanding of the perspectives of the research problem and would also facilitate the researcher to modify and improve the present analytical framework in the right direction to suit the problem situation. The findings of earlier studies would help the researcher in setting the hypothesis and objectives and enable him to compare his own findings. This chapter briefly reviews the concepts and findings of the past studies, which are relevant to the present study.

The review is presented under the following headings for better perception and clarity. This chapter makes an endeavour to study the existing literature on land resources management. Trends of growth in agricultural production, socio-economic conditions of the agriculturists, underlying factors for such growth and justifications of the study have been presented in this chapter.
2.2 Studies related to Land Resources Management

Sharon Aaron et al., (1988)\(^1\) in their study has argued that to understand the rural dimensions of the crisis of contemporary Central America properly, one must view political dynamics in their socioeconomic context and from a historical perspective. Accordingly, the scope of this investigation has been broad, ranging from export development colonial days to labor systems in the nineteenth century to religiously inspired development work in the 1970s to revolutionary and counterrevolutionary armies in the eighties. The following areas are examined. The impact of the major agrarian transformations, the sources of peasant mobilization, the responses by the region’s governments, and the role of the United States.

Mongkolsawat et al., (1997)\(^2\) carried out the study on land suitability for rice a physical evaluation using GIS and the main objective of the study was to prepare spatial model in land evaluation for rice using GIS. The study area is the lower Namphone watershed, which is located in north east Thailand. It covers an area of 3000 sq kms. The evaluation of land suitability classes was based on the method as described in FAO guideline for land evaluation for rainfed agriculture. The overlay process of the selected theme layers has unique information of land

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qualities for which the suitability is based on. The layers of rice include water availability, nutrient availability land form, soil texture and salinisation of soil. These theme layers are collected from existing information and satellite data. Water availability is given by the analysis of rainfall data and irrigation area. Spatial information of nutrient availability was formulated using soil map of land development department. Land sat TM is used to prepare land form of the given area. Soil map gives the soil texture and salinisation of the soil. To create thematic layers the above layers with attribute data was digitally encoded in the GIS database. A polygon layer and the land suitability rating model give the suitability classes or rice. The rice yield with the department of Agriculture Extension is compared with the resultant suitability class. The comparison of the above showed satisfactory output.

Nisar Ahamed et al, (2000)\(^3\) have done the study on crop land suitability model analysis for GIS based fuzzy membership and to achieve optimum utilization of the available land resources. For sustainable agricultural production, crop-land suitability analysis is a pre-requisite. An approach has been recommended by FAO, i.e. the food and agricultural organization for land suitability evaluation for crops in terms of suitability rating from highly suitable to not suitable, based on climatic, terrain data and soil properties crop-wise. Due to

variation of soil properties within the area as well as matching of the soil properties with more than one suitability class to difficult extents encountered with problems while the assignment of a given area element to any one suitability class is applied. No provision is there for assigning partial suitability classes hence the Boolean methods are designed to assign a pixel to single class. To accommodate the above uncertainty in assigning the suitability classes to the pixel. In the present study the use of fuzzy membership classification is used. While assigning the land suitability for crops in the study area of Karnataka, the evaluation of the spatial variability of relevant terrain parameters is carried out in a geographic information system environment. Soil suitability analysis is carried out by fuzzy membership classification. In this nine parameters are considered. Due weightage factors are also included to accommodate the relative importance of the soil parameters governing the crop productivity. According to the field information, the crop being grown in maximum area is finger millet. However the crop-land evaluation results of the present study reveal that maximum area is potentially suitable for growing groundnut.

Dayawansa (2002)\(^4\), carried out suitability land identification for a forest production through GIS technology and this study mainly deals with identification of suitable land parcels for a production forest. Forest plantation has been

\(^4\) Dayawansa, N.D.K., Land Suitability Identification for a Production Forest through GIS Techniques, www.gisdevelopment.net/application/environment/overview/ mi03148abs.htm
specifically planted for production forest on economical objectives. To identify suitable areas within the University of Peradeniya, Srilanka for a production forest, the land suitability analysis has been carried out. In identifying the suitability, the important factors considered are climate, topography, accessibility, slope, soil and vegetation. Climate and soils in this study are considered as homogeneous throughout the study area. From existing topographic map sheets of 1:10000 scale and the land use/cover map of the area of 1:10000 scale, the required spatial layers were obtained. These obtained spatial layers were digitized and incorporated into the Geographical Information System environment. The suitability criteria have been identified as areas with non permanent land use, areas having 30-60 per cent land slope, good accessibility (at least 50 meters from existing road) and the areas away from five hazards since sporadic incidences of fire are reported in the area. For further analysis the digital layers were reclassified and given weightings. Finally, with three suitability categories namely suitable, moderately suitable and not suitable the suitability map is prepared. According to the finally prepared suitability map, 5.35ha of land is under highly suitable category and 0.65ha of land is under moderately suitable category, the majority of the land 68.5ha is not suitable according to the given criteria. Before implementing any aforestation activity, for further verification it is recommended that a field checking should be carried out in suitable and moderately suitable land areas.
Shamala Rasheed et al., (2002)\(^5\) carried out study on remote sensing and GIS synergism for agro-land suitability assessment for sugarcane and rice. In the arid environment the natural resources are declining its productivity and require special attention, and if the ecological condition persists, a further decline in resources may result in land degradation. The optimum solution regarding the land use planning should be identified. Over the traditional procedures remote sensing has its advantages and has shown greater potential in agricultural mapping and monitoring in terms of cost effectiveness and timeliness in the availability of information over larger areas. GIS is a powerful tool than conventional data processing systems. It provides a mean for manipulating and combining datasets. This study deals with finding out the agro-land suitability zones for the major economic crops of that area. For assessing the land for specific use land suitability evaluation process is used. For land suitability evaluations, the terrain characteristics, soil quality and climate conditions are important. In relation to individual crop requirements the suitability for various potential land uses are identified. Land qualities needed for sustained production describes the land use requirements. Using GIS and remotely sensed data the land evaluation was formulated with the objective of classifying units of land as to their suitability for combining economic crops. In this study the study area Vellore district covers

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extensively in the Polar Basin, Northern Tamilnadu. Rice and sugarcane are the major economic crops in this area. Agro climatic units and agro edaphic evaluation results the crop suitability. Slope, soil type, soil texture, soil depth, soil moisture regime, water availability, mean annual precipitation and number of dry months are the topographical details to be analyzed for suitability mapping. For land evaluation the suitability is based on the FAO framework. To create land units of unique characteristics, the various thematic layers are overlaid. Using AHP technique the factor ratings and values for each agro-land characteristics are done. With regard to rainfed and irrigated conditions suitability distribution (very suitable, suitable, moderately suitable, marginally suitable and not suitable) are obtained. In agricultural planning and for developing and driving a best practice system to achieve a scale of operations land suitability mapping can be used as a guideline.

Dale et al. (2000)\textsuperscript{6} in their study has shown that there are five fundamental and helpful ecological principles for the land manager and for people who need them. The ecological principles relate to time, place, species, disturbance and the landscape and they interact in many ways. It is suggested that land managers could follow these guidelines:

- Examine impacts of local decisions in a regional context.
- Plan for long-term change and unexpected events.

• Preserve rare landscape elements and associated species.

• Avoid land uses that deplete natural resources.

• Retain large contiguous or connected areas that contain critical habitats.

• Minimize the introduction and spread of non-native species.

• Avoid or compensate for the effects of development on ecological processes.

• Implement land-use and land-management practices that are compatible with natural potential of the area.

Traintafilis (2001)\(^7\) carried out research study in the department of Soil Science and Chemistry, the University of Sydney, Australia to know the specified kind of land utilization and assessment used in land evaluation in an agricultural context. To partition the landscape into suitable and unsuitable area for a particular land use of interest in map is the final result of agriculture evaluation. By a fizzy approach land suitability could be better expressed. Fizzy methodology has been used to evaluate land suitability in the Edgeroi district for crops including barley, dry land cotton, oats, pasture, soybeans, sorghum, sunflower and wheat. This can be achieved using a membership function to derive land-suitability score ranging from 0-1 i.e. non-suitable (0) to suitable (1). To highlight the most

productive units of soil, an expression for overall land suitability and its capacity with respect to suitability, to particular rotations has been introduced.

Robert A. Van Lonklhuyzen (2004)\(^8\) carried out study on suitability modeling of potential wetland sites. Mitigation using GIS, to compensate unavoidable impacts wet land mitigation is frequently received. The critical factors influencing the functions that create wetlands perform are wetland site conditions and land scape context. Spatial model has been developed and used. Geographic Information System (GIS) is used to identify suitable location for wetland mitigation sites. To characterize site conditions like hydrology, soils, historic condition, vegetation cover, adjacent vegetation and land use the model used six variables. For each variable a set of suitability scores was developed which indicates the wet land establishment potential for different variable states. From the weighted geometric mean of suitability scores for each variable at each point, composite suitable scores for individual points on the land scape were determined. These composite scores can be grouped into five classes and mapped as wetland mitigation suitability surface with GIS site with high suitability scores. To identify the suitability of location as wetland mitigation sites at any site or region the above said model could be useful for planners.

Anthony Young (2004) in his book Land Resource Issues states problems in land use planning and resource management, arising from the interactions between human society and the natural environment. This chapter identifies the key land resource issues for ‘the three worlds of the tropics’ the major agro-ecological zones; the humid tropics or rain forest zone, the sub humid tropics or savannas, and the dry lands, semi-arid and desert. Cutting across these climatic regions are two distinctive environments; steeplands and alluvial lowlands. Land resource issues are related to the essential nature of sustainable land use; combining the efficient use of resource to meet present needs with their conservation for the future. Many issues are concerned with the avoidance of land degradation.

The concept of land resource brings together two of the principal aspects of land use planning and management, making the best use of resources, and conserving them for the future—in short, sustainable use of the land resources. Land resource issues affect the state or condition of resources, but are not problems of the physical environment alone. They arise from the interactions between resources offered by the physical environment, the needs of land users, competition for land, and methods of land management.

Many other problems and policy issues have major impacts on land, but are not land resource issues as such. Examples are marketing facilities, supplies of

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agricultural inputs, veterinary services, and pricing policies. But all land resource issues are necessarily also ‘people issues’, arising from the relations between human society and the land.

Some land resource issues are found in most parts of the developing world. Food security in relation to population pressure is an example, or urban encroachment on agricultural land. Other issues are specific to particular types of environment, or are found more acutely in certain environments, such as water shortage in semi-arid and arid regions, or soil erosion on sloping land. This chapter is a summary of the major land resource issues in different regions of the developing world.

“Three worlds of the tropics”, the major agro-ecological zones, are taken as a framework; the humid tropics or rain forest zone, the sub-humid tropics or savanna zone, and the dry lands. These cover the semi-arid and arid zones which extend from tropical to subtropical and warm temperate latitudes, including the summer rainfall or Mediterranean zone. In addition, there are two environmental regions: humanity as a whole and the perceived special role of rain forest in the atmospheric carbon dioxide cycle.

Liu Li-wei et al., (2005)\(^\text{10}\) carried out study on evaluation of multi-suitability cultivated land based on GIS in College of Resources and Environmental Sciences, Wuhan University, China. For this using weighted

average model and limited factor model the niche-fitness and limited factors of rice, wheat, cotton, and rope in Houhu farm area of Jianghan plain are analyzed. This niche-fitness theory and GIS can be applied to the research on multi suitability evaluation. The environmental conditions meeting the requirements of crop in the area can be indicated through the high values of the niche-fitness i.e. 0.96 degrees of suitability are satisfactory can be estimated by suitability evaluation of single crop. Using comprehensive suitability evaluation we can say that acreage for grade lies highly suitable for cultivation accents for 18.16 per cent of total cultivated land area, for grade 3 and grade 4 for 8.9 per cent.

Brinkman’s (2005)\textsuperscript{11} article “Land Quality Indicators”, may in future have a useful function on a world scale and for national reporting, for example to UNCSD. But for any more detailed or specific purposes, such as policy advice at national level, or management or planning advice in provinces or districts or smaller farming areas, indicators would not provide the sound, process-based information needed. That can only be derived from investigations using real data, interpreted for the purpose rather than aggregating a priori using a predetermined procedure.

Farook Nimbal et al., (2005)\textsuperscript{12} in their article remarked that Indian agriculture depends on monsoonal rain, due to lack of irrigation facilities. Indian agriculture is pegged by natures’ vagaries, semi commercialized farming,
predominance of small farmer, irregularities of monsoon, low level productivity, disguised unemployment, increasing pressure of population, excessive use of fertilizer and pesticides, defunct land reforms, poor techniques of agricultural production etc.

The significance of agriculture in India arises from the fact that the development in agriculture is an essential condition for the development of the national economy.

Manjunatha (2005)\textsuperscript{13} in his study revealed that soil moisture plays a very important role in land preparation and sowing operations. These operations can be precisely done with the help of MB plough, tillers, seed cum fertilizer drills. Proper placement of fertilizer into the moist zone can be achieved through seed cum fertilizer drills. Timely operation of plant protection measures and harvesting and threshing can be done with the help of power sprayers, combined harvesters etc. Due to mechanization in these operations, yield improvement besides saving in cost of cultivation can be achieved in turn resulting in more returns per unit land. Hence, mechanization of dry land agriculture plays a very important role in crop production in India. There is a need to adopt and use improved implements and machines for optimum crop production.

\textsuperscript{13} Manjunatha, Precision Dry Land Agriculture, Kisan World, 32(12):2005, p.43.
Kenneth Peprah (2005)\textsuperscript{14} in his article argued that the Global Environmental Facility (GEF) funded the United Nations University project on people, Land Management and Environmental Change (UNU/PLEC) 1998-2002. The project aimed at biodiversity conservation in small farms. The purpose was enhancement of food security, rural livelihoods and environmental integrity. PLEC adopted a win-win scenario. Project key players were small farmers, multidisciplinary scientist and policy agents. Their collaborative work took place at 100 sq km demonstration site. The case in point is Gyamfiase-Adenya demonstration site in Ghana. Farm holdings were between one and eight unit farms per farmer. Farms barely exceeded 2 ha. Farms were reasonably close to farmers’ permanent residences. Farmers were organized under an association. Members exchange knowledge about cultivation. Farmers kept biodiversity agro-forestry farms, home gardens and backyard forests. Farmers had regenerated agro-forest from grass covered land at Bewase and Duasin. They maintained group nurseries as well as individual commercial plant nurseries. Individual ventures were more successful. They also tended a sacred grove, group and individual citrus farms. Vegetation transitional sequence, forest-to-cropped land-to-grass vegetation was evident at part of the sacred grove slashed for farming. The scared grove suffered resource abuse. Some farmers undertook snail and fish farming. Initial snail harvest was quite encouraging. The association’s swine dispersal

project was saddled with problems. PLEC scientists introduced farmers to split corm and mini set techniques for plantain and yam propagation respectively. They also identified and selected exceptionally successful farmers in biodiversity conservation on farm as expert farmers. Their farms were biodiversity conservation epitome for other farmers and school children. Expert farmers also served as farming consultants. PLEC scientists and expert farmers participated in plant policy formulation meeting. Policy agents drew from their rich indigenous knowledge. A scientist donated cassava-grating machine to the farmers association. Indigenous farmers are successful land resource managers. They are motivated by the economic incentives. When this is nil land resources suffer abuse. Generally, association members have sustainable improved food security, livelihoods and environment.

Sharma et al., (2006)\textsuperscript{15} in their books remarked that rainfed agriculture occupying 68 per cent of country’s cultivated area and supporting 40 per cent human and 60 per cent livestock populations, produces 65 to 91 per cent cotton, pulses, cereal and oilseeds. However, aberrant monsoon causes frequent droughts, resource poor farmers and low investments, eroded and degraded soils with low water holding capacity and multiple nutrient deficiencies, declining groundwater table, etc., converge to low crop yields and contribute to land degradation. Land use diversification involving multidisciplinary approach and including interactions

among climate, soil, water, vegetation, livestock and socio-economic dimensions in devising most remunerative, eco-friendly and environmentally sustainable land use is essential for maximizing the crop productivity, profitability and sustainability of the rainfed agriculture. Characterization of bio-physical and socio-economic resources, integrated watershed development; improvement of rainwater use efficiency, contingency crop planning, diversification of agriculture, live stock farming, alternate land use, integrated soil-nutrient-water-crop management, appropriate farm implements, evolving and institutional framework, extensions of crop insurance, improving credit availability and input supply systems, and launching pilot projects in farmers participatory mode will ensure long-term sustainability of rainfed agriculture in India.

Vinay Thakur et al., (2006)\textsuperscript{16} in their article concluded that land is the habitat of man and its wide use is crucial for the economic, social, and environmental advancement of all countries. Although it is part of man’s natural heritage, access to land is controlled by ownership patterns. Land is partitioned for administrative and economic purposes, and it is used and transformed in a myriad ways. Population growth, technological and social hazards, and environmental degradation have all to be taken into greater account today by policy makers, resource planners, and administrators who make decisions about the land. They need more detailed land information than has been traditionally

available. Although the printed map is still useful, computerized systems offer improved ways of acquiring, storing, processing and retrieving such information.

Further they also concluded that it is desirable to have properly georeferenced land records data and its integration with other land parameters for planning and decision making. It is important that cadastral survey using latest technology may be done for the entire country. Disputed cases in land titles should also be decided at the earliest. Computerisation process should integrate registration of land titles. Land laws/mutation process should be simplified for easy and fast implementation of computerization.

Sudhir Sharma et al., (2007)\textsuperscript{17} in their study showed that to attain success it is necessary that, a major thrust is needed for sustainable development by higher production and value addition for maximizing benefits to the farmers and to the nation. The agricultural price policy has to be thought out within an integrated framework for all economic policies both domestic and external.

Suresh Sactideva (2007)\textsuperscript{18} in his article found that the adoption of modern techniques in farming has helped farmers to improve their economic status, particularly in states of Karnataka, Andhra Pradesh, Maharashtra and Punjab. Integrated Pest Management (IPM) is a successful alternative plant protection

\textsuperscript{17} Sudhir Sharma and Babita, Contribution of Indian Agriculture in India’s Trade in Post Reform Period, Southern Economist, 45(19): February, 2007, pp.5-8.

model which is widely adopted in the country. It is more safer, economical as well as effective.

Alezzy Ahmed M. Aloqob et al., (2007)\textsuperscript{19} in their article found that Yemen is a famous country in coffee cultivation. The productivity has been very less, it is important to find out the reasons for the low productivity and give solutions to this problem. It is also important to identify the areas, which are ideal for the cultivation taking into account the various geospatial. This study forms a guide for public decision making regarding coffee cultivation with other competing crops like oats.

Feras M. Ziadat (2007)\textsuperscript{20} carried out study on classification of land suitability using different information sources. The main objective of this research is to explore accuracy of land suitability. Classification has been derived from soil maps and the use of interpolation between field check or ground truth provides better chance of accuracy for estimating suitability map. The accuracy of suitability map is very high in land utilization that tolerates wide range of land characteristics. The special distribution of suitability classification derived from soil attributes indicate realistic pattern. The predicted model will provide no other source for soil information in the areas were soil map is not available.


Chandrasekaran (2007)\textsuperscript{21} in his paper remarked that trade liberalization and reforms have had a positive impact on services. In particular, revolution in CIT sectors has imparted tradability to services, which were hitherto considered untradable. The boom in the Indian services sector is mostly caused by CIT. Services sector has both forward and backward linkages with other sectors particularly with industry. Service sector needs manufacturing as the base on which ‘services’ can be rendered.

Yellaiah (2007)\textsuperscript{22} in his paper titled ‘Agricultural Lands: An Observation of Telangana A.P.’ remarked that agriculture is the main occupation for the people of Telangana like any other region in this country. Though Andhra Pradesh is known as the Grain Bank of South India, lacs of acres of land is becoming redundant and fallow due to lack of water facilities. The migration of farmers, agricultural labourers to other regions far and abroad for survival shows the down fall of the development of any region.

Floor Brouwer (2008)\textsuperscript{23} in his book viewed that the relationships of driving forces causing changes in the quality of land are complex. Changes in the quality of land use have their basis grounded in intensification and scale, which if regulated based on the quality of land can serve to conserve and improve land quality and its inherent properties related to productivity, biodiversity and

\begin{itemize}
  \item \textsuperscript{23} Floor Brouwer, Dynamics of Land Use in Different States of India, Agricultural Economics Research Review, 5(1):2008, pp.22-33.
\end{itemize}
composition. These properties essentially ought to be more lucidly included in local and regional management schemes and policy measures. Suitability flow charts and land classification systems may help to facilitate this inclusion.

Daniel Hidalgo et al., (2010)\textsuperscript{24} in their study estimate the effect of economic conditions on redistributive conflict. They examine land invasions in Brazil using a panel data set with over 50,000 municipality. Adverse economic shocks, instrumented by rainfall cause the rural poor to invade and occupy large landholdings. This effect exhibits substantial heterogeneity by land inequality and land tenure systems, but not by other observable variables. In highly unequal municipalities, negative income shocks cause twice as many land invasions as in municipalities with average land inequality. Cross sectional estimates using fine with region variation also suggest the importance of land inequality in explaining redistributive conflict.

2.4 Studies related to Cropping Pattern

Some studies have focussed on the use of modern machineries and its impact on cropping pattern, cropping intensity, yield, etc. Pudasaini (1979)\textsuperscript{25} compared the mechanization strategy as combination of mechanization practices with traditional method of farming in Bara district of Nepal. A sample of 102


farmers was selected through stratified random sampling and regression analysis was conducted on the data. It was found that mechanized farm has more crop yield per unit area, higher cropping intensity than the traditional farms.

As far as the concentration of extension network is concerned it is higher where there is an assured irrigation with large scale farming. Desai et al., (1989)\textsuperscript{26} carried out a study in Andhra Pradesh for the operational impact of training and visit. The analysis shows that still the greater concentration of the system seems to be continuing on big farmers and those with more than half of the irrigated area. The regularity of contact between the farmers and extension workers is not properly undertaken. This view has also been supported by Chambers et al., (1980). It clearly indicates that extension officials do not give more importance to the dry land agriculture, but at the same time one cannot forget that Indian agriculture is predominantly occupied by the dry cultivated area where we need more extension services to attain more production.

Perumal (1979)\textsuperscript{27} explained in his article “Effective Use of Farm Leaders in Extension”, that the new extension system increases the use of inputs and consequently resultant rise in production has been quite significant. He also stated that the extension also induced the farmers to use the machineries like tractor and threshers, pumpsets, dusters and sprayers. It indicates that the extension agents


\textsuperscript{27} Perumal, A.K. Effective Use of Farm Leaders in Extension, Productivity, Vol.17, 1979, pp.165-168.
not only concentrate on the use of inputs but also give ideas to use the modern machineries and its advantages to the cultivators.

Harris (1980)\textsuperscript{28} found that the farmers were using tractors for ploughing wet land mainly to avoid delay of transplanting. Before this, the tractors had reportedly been used only for dry-land ploughing and for HYV threshing for the HYVs are difficult to thresh by hand because of their short stems and tough rachis.

A study was undertaken by Dutta (1997)\textsuperscript{29} to examine agricultural production efficiency and farm size of major crops. The district of Ranchi was selected for the purpose of small farms and large farms and peasant farms and capital farms. The study revealed that the small size farms are relatively more efficient than the large sized farms in the production of paddy, while the large farms were relatively more efficient in the production of wheat. With regard to potato, no clear evidence of efficiency differences between small and large farms has emerged. The peasant farms were more efficient than the capitalist farms with regard to all the three crops of paddy, wheat, and potato.

Mahendra Sing’s (2011)\textsuperscript{30} study is concerned with focus on structural changes during last six decades in different land use classes and land use groups. It also shows the prediction of their share for the year 2010 and 2010 in Eastern

\textsuperscript{28} Harris, S., Agricultural Production, Efficiency and Farm Size of Major Crops in Ranchi District in U.P., Indian Journal of Agricultural Economics, 42(3):1980, pp.338.344.
Uttar Pradesh, state of Uttar Pradesh and all India level. The one-step transitional probability matrix showed that the group of net area sown is the most stable with 86 percent probability followed by barren land, non-agricultural use, waste land and forest, while other classes showed zero probability of stability in eastern Uttar Pradesh during various decades in study period. In Uttar Pradesh also the class of net area sown ranked first position with 90 per cent probability of stability followed by non-agricultural uses, forest, miscellaneous tree and barren land. At all India level it is observed that net area sown ranked first with 64 percent probability of stability followed by non-agricultural uses, barren land and area under forest. The one-step transitional probability matrix of various ecological groups of eastern Uttar Pradesh showed that non-agricultural uses category was highly stable (100 percent probability) followed by agricultural uses., desirable ecological and un-desirable ecological sectors. In Uttar Pradesh also non-agricultural uses was most stable (78 % probability) followed by undesirable ecology and agricultural uses, while at all India level non-agricultural use ranked first, followed by agricultural use, un-desirable ecology and desirable ecology categories. The projections for different land use classes and groups indicated that the area under agricultural sector would stagnate while area under non-agricultural uses would increase significantly by 2010 and 2020 in eastern Uttar Pradesh, Uttar Pradesh and at all India levels. Taking away area from agricultural and ecological sector into non-agricultural sector would not be conducive for future food security
and sustainability of agriculture sector and this trend should be arrested through suitable perspective land use planning.

Subramaniyan et al., (1988)\textsuperscript{31} in their study says that there are a large number of studies at all India level on the rates of growth of agriculture in regard to area, yield and output of both food and non-food crops. But studies relating to the above aspects at the state level for individual crops are extremely limited. Keeping this point in view, an attempt has been made in this study to estimate the rates of growth regarding area, yield and output for major crops in Tamil Nadu. The selected crops for this study are paddy, \textit{cholam} (Sorghum), \textit{cumbu} (pearl millet), cotton, sugarcane and groundnut. These are the major crops and account for more than 70 per cent of the gross cropped area in the State. The analysis based on time-series data from 1961-78. The main source of data for this study has been season and crop reports pertaining to Tamil Nadu. It is to be noted that such a study could prove of great avail not only in assessing the performance of individual crops over a period of time but also in identifying factors responsible for such performance.

Prem Prakash Dubey et al., (1988)\textsuperscript{32} in their study revealed that the existing resource use pattern on various sizes of farms in eastern Uttar Pradesh is not optimum. The optimum resource use plans developed for various sizes of farms have shown a high potential for increasing income and employment with the


\textsuperscript{32} Prem Prakash Dubey and Chandra Sen, Resource Use Planning in Agriculture-A case Study of Chiraigaon Block in Eastern Uttar Pradesh, Agricultural Situation in India, April, 1988, p.41.
existing level of resources itself. Significant increase in the income and employment level on various sizes of farms was observed due to increase in cropping intensity as well as transfer of area from cereal crops to cash crops, i.e., potato, sugarcane musk melon and other vegetables.

Klaus W. Deininger et al., (2003)\(^\text{33}\) in their paper concluded that developing countries and countries in transition, land law and land tenure are still unresolved problems cementing rural and urban poverty. Systematic integration of the ‘land issue’ into Poverty Reduction Strategy Papers (PRSP) is all the more warranted because, for the poor, land is a vital production factor and an asset; and then indirectly because secure land rights impact on investment and (rural) growth.

Uschi Eid (2003)\(^\text{34}\) in his paper found that there is now widespread consensus throughout the world that access to land is key to reducing poverty in rural areas and implementing the right to food, heated debate has broken out over the market-assisted land reform approach. This debate sometimes suggests that there are irreconcilable ideological differences surrounding this issue that could jeopardize the valuable basic consensus people have fought so hard to achieve.

Jerzy Plewa (2003)\(^\text{35}\) in her article reveals that in preparation for accession to the EU, Poland has launched state support programmes in an effort to

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\(^{35}\) Jerzy Plewa, Land reform in Poland on the eve of EU accession, agriculture rural development, Vol. 10, No. 2/2003, (ISSN 1619-8891).
consolidate agricultural land tenure, which is currently still very fragmented. Despite numerous measures taken, development of the agrarian structure is not yet satisfactory and the desired number of economically viable holding has not yet been reached.

Wolfgang Werner Windhoek (2003) in Namibia—the driest country in Sub-Saharan Africa land is highly unequally distributed. Due to a racially structured policy Namibia’s heritage at Independence was a dualistic land tenure structure, consisting of areas where land is held under freehold title and areas where no ownership of land or freehold title can be obtained. Since independence, land reform has concentrated on broadening access to freehold land for previously disadvantaged Namibians by transforming large-scale freehold farms into smaller agricultural units. Land tenure issues in non-freehold areas, however have not featured prominently in land reform.

Chael Kirk (2005) in his article argued that most calls for recognition of land as a human right are geared to ways of ensuring fairer treatment of specific target groups, namely the landless and the land poor in rural areas, who are often at the centre of lobbying activities by Non-governmental Organization (NGO) and civil society coalitions. This discussion, however, often overlooks the fact that the importance of access to land in rural areas has changed substantially due to

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36 Wolfgang Werner Windhoek, Namibia wwerner@iway.na, Land Redistribution and Tenure Reform in Namibia, Agriculture Rural Development, Vol. 10, No. 2/2003, (ISSN 1619-8891).
migration to more urban-oriented industries and services, as well as new off-farm income-earning opportunities in both downstream and upstream rural sectors. Another question thus arises here: In a more dynamic context, does not the acknowledged, albeit sometimes scarcely realizable, right to work include access to land as a production factor?

Restricting the debate to arable and pasture land often disregards the fact that the rural poor depend on a combination of many different rights of access and use of the widest range of different natural resources in order to secure their livelihood and that therefore, a narrow definition of “right to land” generates new problems ultimately leading to new exclusion problems for the poor.

Ajanta Nath et al., (2008)\textsuperscript{38} in their paper found that Assam lags behind the rest of the countries in all the key indicators of agricultural development be it irrigation, level of mechanization, cropping intensity, market access or connectivity of the rural areas. Importance of irrigation in agriculture is supreme, because it enables multiple cropping in the sown area. At present crop intensity in Assam happen to be around 130 per cent but Punjab has achieved a crop intensity of 164 per cent only through intensive irrigation. There is surplus production of fruits and vegetables but forty percent of the crop is lost because of poor harvest losses. The future of rice production too, is not assured in the stage, largely because of poor price realization. The farmer is finding it difficult to increase

productivity, where input cost is steadily going up and price of producing steadily falling. The institutional credit structure is weak in the stage.

From the study it reveals that highest production of different agricultural crops produced by different districts, e.g. the highest producer of miscellaneous crops, pulse, cereal crops and oilseeds, rice and fish are Kokrajhar, Goalpara, Golaghat and Nagaon respectively. So each and every district should get the facilities equally which are provided by the Government, so that no district remain as backward as in case of modern development in agriculture. Assam has vast water resources. Beel and river fisheries provide opportunities for fishery development in large scale. A large section of people can earn their livelihood from them. The agriculture department should be reorganized to establish a close and friendly relationship with farmers. Higher production per acre can easily be achieved through the use of improved seeds, manures, irrigation, flood control, through double and triple cropping etc. Sometimes Government department supplies inferior seeds to the farmers; such type of detrimental work should be stopped completely by the Government with iron hand.

Khanna (2009)\textsuperscript{39} in his paper reveals that water is essential for living. But in the present scenario, water has ceased to be easily available for consumption. This paper delves into the challenges that this sector is facing. In the process, it addresses concerns of water availability, level of utilization, the disparity there of,

and plans to manage and solve the quantitative and qualitative aspects of the resource availability.

Michael Winter and Matt Lobley, (2009)\(^{40}\) in their book viewed that we have sought to set out some of the key issues that are relevant to the new land use debate and to set the scene for the wide-ranging material presented in this book. We have a commitment to both interdisciplinary and policy application. The book is essentially about knowledge of the land. But of course there are many different types of knowledge and the book as a whole contains contributions from a range of scientific disciplines that display different ways of knowing land and the issues relevant to the management and use of land. Conceptual unity has been less important to us than the urgent (and prior) need to establish a baseline of evidence and ideas. Following introduction, the book is divided into two sections. The first section covers a range of new technologies and uses for land that directly or indirectly impinge on the management of land, such as anaerobic digestion and energy crops, as well as ways of using land to manage water. It also provides state-of-the-art reviews on key issues relevant to the role of the land in climate change adaptation and mitigation. The second section of the book picks up on some of the issues and conflicts that these emerging technologies, capacities and demands give rise to. John Hopkins explores the implications for biodiversity of climate change and some of the policy aspects of this are also covered and serve to

remind us of the breadth and challenge of the new land use debate, which encompasses not only the natural and social sciences, but also the arts and philosophy and ethics.

For society as a whole, what we ‘know’ about land is determined in part by why we have sought to know some things but not others. The reason for this book is our strongly held perception that the importance of land to our survival as a species cannot be underestimated. As the challenges facing us escalate, so our need grows to take stock of what we know and what more we need to know about land.

Jha and Sinha (2010)\textsuperscript{41} in their article found that groundwater is the most preferred source of water in various user sectors in India, on account of its near universal availability, dependability and low capital cost. The increasing dependence on ground water as a reliable source of water has resulted in indiscriminate extraction in various parts of the country without due regard to the recharging capacities of aquifers and others environmental factors. On the other hand, there are areas in the country, where ground water development is suboptimal in spite of the availability of sufficient resources, and canal command areas suffering from problems of water logging and soil salinity due to the gradual rise in ground water levels. As per the latest assessment, the annual replenishable ground water resource of country has been estimated as 433 billion cubic meter

(bcm), out of which 399 bcm is considered to be available for development for various uses. The irrigation sector remains the major consumer of ground water, accounting for 92 per cent of its annual withdrawal. The development of ground water in the country is highly uneven and shows considerable variations from place to place. Though the overall stage of ground water development is about 58 per cent, the average stage of ground water development in North Western Plain States is much higher (98%) when compared to the Eastern Plain States (43%) and Central Plain States (42%). Managing ground water resources in the Indian context is an extremely complex proposition. The highly uneven distribution and its utilization make it impossible to have single management strategy for the country as a whole. Any strategy for scientific management of ground water resources should involve a combination of supply side and demand side measures depending on the regional setting.

As far as ground water resource availability is concerned the share of alluvial areas covering Eastern Plain states of Bihar, Orissa (part), Eastern Uttar Pradesh and West Bengal and North Western plain states of Delhi, Haryana, Punjab, Western Uttar Pradesh, Chandigarh; is about 44 per cent of the total available resource. However, these groups of states have overall development of the order of 43 per cent and 98 per cent respectively. In view of the marked difference in stage of ground water in these areas, there is a need to critically analyze the underlying factors responsible for the imbalances in terms of technical and socio-economic considerations. These should also be taken for consideration.
while formulating any comprehensive water resources management initiatives for the country. There is urgent need for coordinated efforts by various Governments and non-governmental agencies, social service organizations and the stakeholders for evolving implementable plan for effective management of this precious natural resource.

Gnana Elphinstone et al., (2010)\textsuperscript{42} in their article concluded that the farmers prefer to cultivate cash crops and the cultivation of food crops is neglected. Moreover in the district, farmers convert their agricultural land into land of non-agricultural purposes. This is mainly due to unremunerative price, low profit, labour shortage, disturbance of wild animals, irrigation problem, less involvement of other family members and disease. These are the factors responsible for the change in cropping pattern of Kanyakumari district. Hence conversion of agricultural land for non-agricultural purpose and conversion of paddy fields into rubber and coconut cultivation is enormously taking place. It will certainly result in food scarcity. The government should take steps to control land conversion. Unless land conversion is controlled forthwith, there will be absolutely no paddy cultivation at all in the district in the near future.

In terms of the simple analytical model summarized in equation (1), urban sprawl is treated as an exogenous shift in the supply of land to agriculture $S_L$. United Nations projections suggest that all incremental population growth between

\textsuperscript{42} Gnana Elphinstone, G., Cyril Kanmony, J., Shifting Areas under Cultivation in Kanyakumari District - A Block-wise Analysis, Agricultural Situation in India, Vol.LXVII, April, 2010, p.8.
now and 2050-about three billion people—will translate into additional urban growth argue that such urban expansion poses “one of the biggest environmental challenges for the 21st century” (p. 87), in part because cities are typically established in areas of prime farmland. Those authors start by assuming that average urban population densities of middle/low income countries (7500 people/sq km) will apply to the additional urban growth, resulting in an additional 400,000 sq km of urban land (slightly larger than Germany). This figure is nearly twice as large if the new urban areas are more representative of the global average urban density (just 3500 people/sq km). Of course, urban land currently covers less than one per cent of the earth’s land surface (Houghton 1994) so even this dramatic expansion has only a modest impact in aggregate. However, Byerlee (personal communication) argues that, while the effect of urban expansion will be relatively modest when viewed relative to the global availability of land, urbanization will be an important force in particular regions—creating strong pressure on the availability of agricultural land in China and India in particular.

Rahula Shastri (2010) in his paper finds that tank irrigation is class irrigation: irrigation for large farmers, while in contrast, groundwater irrigation is mass irrigation: favouring small and marginal farms. The state’s neglect of tank irrigation after independence, and the active promotion of other forms of mass irrigation, contradict the premise of landlord control or influence on state policy.

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The class bias of tank irrigation may have had its source in the pattern of alienation of land by large landowners under pressure of development and land ceilings. The class divides between tank and groundwater irrigation forces choice on state policy. This paper suggests that their purported complementarily is highly overrated. Storage tanks are the least efficient form of charging groundwater among alternative water harvesting forms. They cannot be converted into percolation tanks. Further, if groundwater irrigation includes not just well but also harvesting structures, then there is a clear trade off between tanks and wells.

The collective nature of the tank irrigation aggravates its technical deficiencies and leads to neglect. Groundwater being privately managed has organizational resilience. Further, economic use of groundwater may ensure if electricity charges are metered.

Sonika Gupta (2010)\textsuperscript{44} in her paper reveals that the study has been undertaken with the objective of finding the extent of land degradation and its determinants in the mountainous regions of Himachal Pradesh by dividing the state into four zones. Multistage random sampling technique has been adopted to select the sample farmers from each zone. Logit analysis has been carried out to find the probability of different factors affecting land degradation. The factors which have effect on land degradation have been reported. They are: total owned land, land fragmentation, family labour, non-farm income, farm income, non-farm

migration, leasing-out of land and education level of members in a household. The study has suggested some measures to minimize land degradation and consequently increase production and income levels in this difficult terrain of the country.

Amrit Patel (2010)\textsuperscript{45} in his article reveals that agriculture development in India needs to focus on reducing greenhouse gas emissions through measures, such as significant reduction of deforestation; improving forest conservation and management; effective control of wildfires; promotion of agro-forestry for food or energy; soil carbon sequestration; restoring land through controlled grazing; improving nutrition for ruminant livestock, waste (through biogas recovery); and developing strategies that conserve soil and water resources by improving their quality, availability and efficiency of use. While a National Network Project “Impact, Adaptability and Vulnerability of Indian Agriculture to Climate Change” has been launched with a focus on ‘Impact of Climate Change on Different Sectors of Agricultural Production’ it is necessary to make sufficient investments to support climate change to adaptation, mitigation, technology development, transfer and dissemination among farmers.

Francis Kuriakose and Deepa Kylasam Iyer (2011)\textsuperscript{46} in their paper remarked that integrated and sustainable land use comprises of prioritization of

\textsuperscript{45} Amrit Patel, Climate change and agriculture, Need for Mitigation and Adaptation, Kurukshetra, Vol.58, No.5, March 2010, p.52.
\textsuperscript{46} Francis Kuriakose and Deepa Kylasam Iyer, Land Use and Agrarian Relations Issues and Prospects in the Indian Context, Kurukshetra, Vol.59, No.9, July 2011, p.52.
critical land sensitivity, understanding land use and forest response, integrated strategy for forest and pest management, diversification of agriculture, crop combination, use of people’s indigenous knowledge to attain food and nutritional security, increased productivity and address the environmental concerns. This is the way forward towards an evergreen revolution.

Carlo Fezzi et al., (2011)\textsuperscript{47} in their paper develop a spatially disaggregated, structural econometric model of agricultural land use and production based on the joint multi-output technology representation introduced by Chambers and Just (1989). Starting from a flexible specification of the farm profit function, we derive land use allocation, input application, crop yield, and livestock intensity equations in a joint and theoretically consistent framework. To account for the presence of censored observations in micro-level data, the model is estimated as a system of two-limit Tobit equations via quasi-maximum likelihood. We present as empirical application using fine-scale spatial data covering the entirety of England and Wales and including the main economic, policy and environmental drivers of land use change in the past forty years. Simulation of the effects of diffuse pollution reduction measures illustrates how our approach can be applied for agro-environmental policy appraisal.

\textsuperscript{47} Carlo Fezzi and Ian J. Bateman, Structural Agricultural Land use Modeling for Spatial Agro-environmental Policy Analysis, American Journal of Agricultural Economics, 93(4): July 2011, p.1168.
Thomas W. Hertel (2011)\textsuperscript{48} in his paper remarked that factors shaping the supply of land to agriculture having developed some of the key demand side factors, we now turn to the supply of land to agriculture. Here, we are concerned, both with the largely exogenous (to agriculture) factors contributing to the availability of land for farming $f_{l}^{s}$, such as urbanization, demand for lands for preserving biodiversity, and climate change, as well as the anticipated endogenous response to signals of increasing scarcity $f_{s}^{E}$. We expect that land, as well as water availability for irrigation purposes, will be forced to compete with other uses, including forest products, carbon sequestration, as well as other environmental services for which payments might be offered.

Gurpreet Singh et al., (2012)\textsuperscript{49} in their paper examine the relationship between land redistribution and economic wellbeing of households. A large body of literature points out that there is a positive relationship between the two. Our analysis departs from the existing literature in that it considers Human Development Index rather than per capita income alone as the dependent variable. Covering data across Indian states, the paper also discusses implications of its analysis in the light of millennium development goals.


Anithakumari et al., (2012)\textsuperscript{50} in their article analysed the constraints faced by the farming community in root (wilt) affected area was done during 2010-2011 at Alappay district, Kerala, India. It was found that irrespective of the holding size only 50 per cent of the coconut trees were in bearing stage whereas a round one third were seedlings and one fifth pre bearing stage. Adoption of recommended practices was statistically significant with the area under coconut cultivation. The farmers identified 30 major constraints which were categorized as technical, input, economic, social and biophysical constraints in order of importance. Participation of the coconut farmers in meetings related to farming was only 18.9 per cent and participation in training programmes was meager and only 10 per cent of the sample respondents were members in nay farmer groups. The results indicated need for coconut farmers’ clusters / societies for improving technology adoption in community basis.

Souvik Ghosh et al., (2012)\textsuperscript{51} in their analysis of irrigation and agriculture have carried out livelihood and poverty linkage in the districts of Odisha. District-wise scenario of irrigation, agriculture, livelihood and poverty have been revealed with the help of different indexes developed. The value of Groundwater-Development Index has been found low to very low for 25 districts. Created


irrigation potential out of the total potential ranged from 19 to 93 per cent in Kharif and 8 to 61 per cent in rabi season. Half of the districts have shown medium Agricultural Development Index values. Level of living of majority of districts has been found at medium level. About 60 per cent of the BPL rural families comprise agricultural labourers, marginal and small farmers; ranging from 25 to 94 per cent. Balasore, Bargarh, Bhadrak, Cuttack, Ganjam, Jajpur and Puri districts have shown higher irrigation and agricultural development and Deogarh, Dhenkanal, Kandhamal, Malkangiri, Nawapara, Raygarh and Sundargath districts have shown lower irrigation and agricultural development. The links and / or missing links between irrigation resources, agricultural development, poverty and level of living have been explored.

Abayineh Amare Woldeamanuel (2012) in their article found that land is an asset of enormous importance for billions of rural dwellers in the developing world. Increased land access for the poor can also bring direct benefits of poverty alleviation, not least by contributing directly to increased household food security. In countries where agriculture is the main economic activity (e.g. Ethiopia), access to land is a fundamental means, whereby the poor can ensure household food supplies and generate income. Therefore, this study aimed to sketch-out institutional arrangements to get access to farmland and to empirically examine institutional mechanisms to settle dispute arising from contracting farmland in

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Amigna district. The result revealed that land rental markets appeared to be the dominant institutional arrangement to get access to farmland next to Peasant Association allocated arrangement. This created the breathing space for a short-term land acquisition for landless and/or nearly landless farm households. Moreover, the dominant transactions took place among a neighbour followed by transfers between friends in the same peasant association, and relatives in the same peasant association. The foregoing discussion with key informants revealed that such transfers are informal and there are no formal rules and regulations to enforce land transfers to reduce high risk that may arise from these transactions. Regarding the mechanisms used by the sample respondents in order to resolve disputes, farmers claimed their rights through local elders, religious leaders, and local institutions. This may be due to the perception of legal uncertainty over landholdings particularly in the case of rental contracts, which existed informally. Therefore, policy and development interventions should give emphasis to improvement of such institutional arrangements that create venue for land access.

Ashok Dalwai (2012)\textsuperscript{53} in his speech considers it a great honour to be invited as one of the Chief Guests of the Inaugural function of the 71\textsuperscript{st} Annual Conference of the Indian Society of Agricultural Economics. The society has made enormous contributions to the study of agricultural economics in India. It has stimulated the development of a body of knowledge on this subject which is

impressive by any standards and has also been at the forefront of policy thinking on this subject. He feels particularly privileged to deliver this lecture in this event which is coinciding with the Silver Jubilee Year of the University of Agricultural Sciences, Dharwad, which has been at the forefront of development of agricultural economics in the country.

The four themes chosen for this conference, viz., Agricultural Development Perspective and Strategy Planning for the 12th Five Year Plan, Climate Change, Innovations in Agricultural Credit Market and Role of ICT-are the corner stones of the transformation that is taking place in the way Agricultural Economics.

His lecture will focus on the growth of India and examine whether agricultural growth is keeping pace. He will talk about the trends observed in agricultural growth over the last two decades including the rising prominence of ‘high value agriculture’. The other aspects he will dwell on are the thrust areas for accelerating agricultural reforms and the production side interventions that are required. He will, of course, cover Aadhaar and the beneficial role it can play in reaching out to the farming community.

Yutaka Arimoto (2012) in his paper studies an early participatory rural development program implemented during the 1930s in Japan. This program selected several villages each year to draft and implement their own original development plans. I discuss the implications of the features of the program on its

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effectiveness. A detailed baseline survey conducted by the villagers themselves helped them to objectively diagnose their economic situation and understand their issues. The plans defined clear numerical targets, allowing them to share goals and monitor progress. The implementation of the plan was reinforced by frequent communication and monitoring among neighbors and by an incentive scheme that involved competition within a village. I use a village-level panel dataset from Hyogo Prefecture to examine the effects, under the difference in-differences strategy. I find suggestive evidence that the program helped foster the adoption of cattle raising and diversify agricultural production.

Jeena T. Srinivasan (2012)\textsuperscript{55} in his paper examined the yield, input use, and net returns from paddy cultivation in the Kole land, against the backdrop of attempts from the Government of Kerala to increase paddy production in the state. It is seen that the yield per hectare of paddy is very high from the Kole land. However, this is attained with higher input use raising serious concerns on both ecological and economic sustainability. The returns to scale indicate that Kole is operating under diminishing returns to scale. Labour cost constitutes over 65 per cent of the total cost of cultivation. Higher inputs of labour are used for certain activities like land preparation, weed removal, transplanting and harvesting. The increasing trend in the use of weedicides raises serious concerns on soil health and

ecological sustainability. For a large number of farmers cultivation of paddy as a single crop itself is not economically viable and may prefer to exit from cultivation. In such a situation, measures to improve the economic viability of paddy first as a single crop are important instead of recommending double cropping. Better measures for weed control and management would significantly reduce labour cost. Availability and use of machines for transplanting and harvesting is to be improved and promoted. It is seen that medium size padasekharams are more economically viable than the other two categories. Given the average size of individual land holdings in the Kole land, efforts need to be taken to encourage farmers within a padasekharams to carry out cultivation collectively so as to reap some economies of scale and make paddy cultivation economically more remunerative. Similarly, further sub-division and fragmentation of holdings needs to be controlled and the Paddy Land Conservation Act has to be implemented strictly. The study finds greater role for padasekharams and padasekhara samithis as institutions to overcome the constraints imposed by the small size of holdings. This together with a more judicious use of chemical inputs would make Kole land paddy cultivation economically more viable and contribute significantly to the overall goal of enhanced paddy production in the state.
Sebak Kumar Jana et al., (2012)\textsuperscript{56} in their article concluded that there is a limited number of studies focusing on tank irrigation for East Indian states like West Bengal. The results of the preliminary study on tank irrigation in the dry zones of the state bear important policy implications. The following are considered important while making the tank improvement programmes in the state. As vegetables help improve the overall value of tank cultivation, there should be more emphasis on crop diversification through extension activities to improve the productivity of the tanks. The road facilities will further enhance the market value of the commodities and hence the local roads should be given priority for infrastructure investment.

Water availability will improve the tank productivity. It is seen that the average period of water availability for irrigation is about 6 months with variation from 5 to 7 moths. Hence by improving the catchments and field channels, it is possible to increase the water inflows into the tanks. It was also observed that in few tanks with good tank structures, the water availability was also comparatively higher. Also the existing tank structures are very weak and by rehabilitating them, it is possible to improve the overall water availability in the tanks. Hence rehabilitation programme should focus on the tank storage aspects. The field channels also are important for proper water distribution and hence improving the field channels or adding new channels in those tanks where it will help carry the

\textsuperscript{56} Sebak Kumar Jana, Palanisami, K., and Amit Das, A Study on Tank Irrigation Productivity in the Dry Zones of West Bengal, Vol.67, No.2, April-June, 2012, p.66.
water to the fields should be given priority. Grouping of the tanks according to the tank productivity and then initiating the tank rehabilitation options are important in improving the tank performance in the state.

2.5 Operational Definition

Small Farmer

‘Small Farmer’ means a farmer cultivating (as owner or tenant or share cropper) agricultural land up to two acres.

Medium Farmer

‘Medium Farmer’ means a farmer cultivating (as owner or tenant or share cropper) agricultural land of more than two hectare and up to four acres.

Large Farmer

‘Large Farmer’ means a farmer cultivating (as owner or tenant or share cropper) agricultural land of more than four acres.