CHAPTER – II

REVIEW OF LITERATURE

2.1 Introduction

In order to take into accounts the contribution of operations research in profitable farm management, the past work done at national and international level in this regard was reviewed. Many scientists/programmer have made their scientific efforts and operation research methodology to develop the LP model by mathematical programming approach to determine capital dependent steady state cultivation policies.

2.2 Literature Reviewed

Laxminarayan and Rajagopalan (1977) applied LP to get the optimal cropping pattern for Punjab. They determined the area under different crops and amount of water releases from canal and tube well waters to get maximum benefit.

Khan (1982) presented a management model which consider all the important components of an irrigated system and may help to maintain a permanent irrigated agriculture. The model optimize net farm return, maintain favourable hydrologic and salt balance in the irrigated system meets the concentration requirement of the drainage water for individual crops and simulated the impact of the irrigation on the unsaturated and saturated zone.

Khepar and Chaturvedi (1982) used LP to optimize cropping pattern using two resources of water, i.e., canal and ground water for a canal command area in Punjab. The objective was to maximize the net returns of the command area through crop production imposing constraints on land, water availability and water allocation.

Mai et al. (1984) developed a suitable cropping schedule for rabi season in Debra block in Midnapore district using LP. They suggested paddy,
gram, mustard and potato to be grown under lift irrigation without canal supply for achieving maximum benefit.

Butterworth (1985) indicated that in the current economic climate, linear programming could well be worth reconsidering as a maximizing techniques in farm planning. This particularly applied when it was used in conjunction with integer programming which allows many of LP’s problems to be overcome. ADAS (Agricultural Development and Advisory Service) procedures for LP / Integer programming were described. Reference was made to a range of models and more detail given on the new Bedfordshire mixed cropping method. An explanation was given as to how ADAS models are used in advisory and promotional work.

Panda et al. (1985) applied system approach to irrigation planning of a canal command area in Punjab. The objective was to indicate optimal cropping pattern and seasonal water release from canals and tube wells under conjunctive use of surface and ground water to maximize the net annual return using LP and change constrained LP at 5 per cent risk level.

Richard et al. (1990) suggested a methodology for allocating variable input which has been used among crops and improvement of regional crop budget information. Two approaches for estimation of variable input allocations among production activities were examined. One relies on behavioral rules whereby input allocations follow accepted rules of thumb. The alternative approach was derived from profit maximization where input use responds instantaneously to changes in input and output prices. The behavioral rules dominate instantaneous responded to prices in explaining the data analyzed and suggested the validity of a simple behavioral approach for developing enterprise budgets and cost of production estimates.

Glen and Tipper (2001) developed a mathematical programming approach for planning the introduction of improved cultivation systems in a semi-subsistence farm in northern Chiapas, Mexico. This new approach first
used a linear programming model to determine capital dependent steady state cultivation policies. Results from this steady model were then incorporated into a multi period mixed integer programming model for determining steady state policy and the associated improvement plan.

Sethi et al. (2002) developed a groundwater balance model considering mass balance approach. The components of the groundwater balance considered were recharge from rainfall, irrigated rice and non-rice fields, base flow from rivers and seepage flow from surface drains. In the second phase, a linear programming optimization model was developed for optimal cropping and groundwater management for maximizing the economic returns. The models developed were applied to a portion of coastal river basin in Orissa State, India and optimal cropping pattern for various scenarios of river flow and groundwater availability was obtained.

Benli and Kodal (2003) developed a non-linear optimization model for the determination of optimum cropping pattern, water amount and farm income under adequate and limited water supply conditions. The objective function of the model was based on crop water-benefit functions. The model was solved using MS Excel Solver package for conditions existing in South-east Anatolian Region of Turkey. The model gave the optimal distribution of crop areas, irrigation water needs of crops and total profit for the farm under adequate and limited water supplies. The problem was also solved by a LP model, in order to indicate the difference between NLP and LP models. After the examination of NLP and LP model solutions, it could be seen that, the NLP model could give higher farm income values than the LP model under deficit irrigation conditions.

Hassan et al. (2005) mentioned that for the study, irrigated areas of Punjab province was selected for determining optimum cropping pattern under various price options. LP model was applied to calculate the optimal crop acreage, production and income of the irrigated Punjab. Crops included in the models were wheat, basmati rice, IRRI rice, cotton, sugarcane, maize,
potato, gram and moong. The results showed that the irrigated agriculture in the Punjab was more or less operating at the optimal level.

Kerselaers et al. (2007) developed a LP simulations at individual farm-level of potential income changes that may result from conversion to organic farming. The model was based on both conventional farm accountancy data and additional conventional and organic farm data from sector expertise and literature. The model was applied for Belgian agriculture. Simulations showed that economic potential for conversion was higher than generally perceived, provided that farmers were willing to change farm management practices. However, the economic conversion potential (ECP) was not positive for all farms, not even when an optimal conversion process was assumed and it depended on farm type and farm characteristics. Additionally, due to higher risk and liquidity problems during the transition period, the positive results were needed to be put into perspective. Nevertheless, the differentiated ECP calculations could give new insights supporting farm-level policy choices with respect to conversion to organic farming.

Borges et al. (2008) reported that LP models are effective tools to support initial or periodic planning of agricultural enterprises, requiring, however, technical coefficients that can be determined using computer simulation models. Constraints on monthly water availability, labor, land and production were critical in the optimal solution. In relation to the water use optimization, it was verified that an expressive reductions on the irrigation requirements may be achieved by small reductions on the maximum total net present value.

Georgiou and Papamichail (2008) developed a NLP optimization model with an integrated soil water balance to determine the optimal reservoir release policies, the irrigation allocation to multiple crops and the optimal cropping pattern in irrigated agriculture on data from a planned reservoir on the Havrias River in Northern Greece. Decision variables are the cultivated area and the water allocated to each crop. The objective function of the model
maximizes the total farm income, which was based on crop-water production functions, production cost and crop prices. The model was solved using the Simulated Annealing (SA) Global Optimization Stochastic Search Algorithm in Combination with the Stochastic Gradient Descent Algorithm. The rainfall, evapotranspiration and inflow were considered to be stochastic and the model was run for expected values of the above parameters corresponding to different probability of exceedence. By combining various probability levels of rainfall, evapotranspiration and inflow, four weather conditions were distinguished. The outputs of this model were compared with the results obtained from the model in which the only decision variable is Cultivated Areas. The model had great potential to be applicable as a decision support tool for cropping patterns of an irrigated area and irrigation scheduling.

Massey et al. (2008) stated that the objective of case-study analysis was to investigate how site-specific decisions could be improved by transforming a long-term multiple-crop yield-map dataset into profit maps that contain economic thresholds representing profitability zones. Ten years (1993–2002) of cleaned yield map data (4, 5 and 1 yr) for corn, soybean and grain sorghum respectively were collected for a 35.6 ha clay pan soil field in Missouri. Actual input costs and crop prices, published custom rates for field operations, and region-specific land rental prices were used to transform yield maps into profitability maps by year, by crop, and overall for 10 yr. Profit maps revealed that large field areas where net profit was negative, largely due to negative profit from corn production on areas where topsoil was eroded. This analysis demonstrated how changing yield into profitability metrics could help a producer consider and then decide on different management options. The decision process discussed supports a producer's need to manage fields with incomplete information and where satisfying rather than optimizing behavior often occurs. This analysis demonstrated how profit mapping can be of value for a producer and provides impetus for the precision agriculture community to consider profit mapping protocols and standards.
Ndamani (2008) stated agricultural production was largely undertaken by smallholder subsistence farmers who rely solely on highly unpredictable and sporadic seasonal rainfall in Ghana. Maize, sorghum, and groundnut were the main crops cultivated by most farmers, particularly in northern Ghana. The variability in prices of the crops at different markets tends to adversely affect the incomes and food security of poor rural farmers. Avoiding such adverse effects, he applied a spatial equilibrium model to identify market strategies that influence the marketing and production decisions of farmers and the technology dissemination decisions of agricultural staff. The data used in the study included wholesale and retail crop prices (2002-2007), production/yield figures, and commodity transport costs. Data on the Consumer Price Index was obtained from the Govt. of Ghana. In general, the annual average price of maize and sorghum were higher in Wa market than in Tumu or Lawra markets. Comparison of linear and quadratic programming results showed that farmers attain different produce prices (incomes) depending on whether they were price makers or price takers. Farmers in this region were generally risk averse, so they like to ship their produce to different markets. Considering these findings, it was advisable for farmers to form organizations or groups to market their products collectively.

Sudha et al. (2008) discussed about the methods for increasing productivity of water consumed in agriculture is improved by water supply management. They presented that the results from an optimization study of the Malampuzha irrigation project of the Bharathapuzha river basin of Kerala in India. The objective of this study was to determine whether significant improvements might be realized from optimization of operation of the reservoir system. To do this a MILP model was developed and five different management strategies were tested. The result indicated that a management strategy with deficit irrigation by supplying less water in non-critical growth period and maximum water during stress sensitive periods was a best viable solution for better performance. A MILP Model, rather than a LP model, was used to ensure that the reservoir did not spill before reaching its capacity.
Salami et al. (2009) developed a LP model to estimate the direct costs on agriculture, and a macro econometric model to trace the indirect impacts on the rest of the economy in Iran. The results indicated that a severe drought such as the one that occurred in the crop year 1999–2000 imposes a direct cost of 1605 million US$, equivalent to 30.3 per cent of the total value added of the cropping sector in Iran. This, in turn, lead to a 12.7 per cent reduction in the value added of other agricultural sub-sectors (livestock, fisheries and forestry). Thus, such a drought reduces overall GDP by about 4.4 per cent and it would also resulted in decreased non-oil exports, increased food imports, and a rise in inflation. The results of some drought mitigation simulations were reported in brief. Such estimates strengthen the case for increased attention to drought strategies and management in agriculture in Iran and elsewhere.

Panigrahi et al. (2010) suggested a mathematical model for optimal allocation of area to different crop sequences with different objectives viz. minimization of soil loss, minimization of investment and maximization of net return from agriculture and was solved using LGP technique. The model suggested to take up food crops in area of 1,30,777 ha and perennial grass cover in 3223 ha with a cropping intensity of 1.61 resulting in a net return of Rs. 1064.775 millions sustaining soil loss to a tune of 9489.67 thousand tons per year. The model was found to be favorable in respect of higher net return of Rs. 8862.34 and lesser soil loss of 23.41 tons/ha than the corresponding present values. But more investment of Rs. 4489.01 per ha was required to fulfill the objectives.

It reveals that a management model which consider all the important components of an irrigated system and may help to maintain a permanent irrigated agriculture. It was found that the NLP model can give higher farm income values than the LP model under deficit irrigation conditions. It is also found that the LP models are effective tools to support initial or periodic planning of agricultural enterprises. It is lighted that the LP model had great potential to be applicable as a decision support tool for cropping patterns of
an irrigated area and irrigation scheduling. It also shows that the results from the steady model can be incorporate into a multi period MILP model for determining steady state policy and the associated improvement plan. The comparison of linear and quadratic programming results showed that farmers attain different produce prices (income) depending on whether they were price makers or price takers.