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Impact Of Irrigation Delivery On Groundwater Case Study: Parabikulam Aliyar Project In Tamilnadu,India.

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ABSTRACT

The Parambikulam Aliyar Project is a unique project showing the symbol of interstate cooperation by sharing water. This project interlinks 8 Reservoirs in various altitudes located in four sub basins. This study is carried out to assess the impact on the groundwater due to introduction of Alternative Sluice Method of Irrigation in this Project area during the year 1999 is carried out using the groundwater level fluctuation and the rainfall in this area. The groundwater level of 17 observation wells and the monthly rainfall of 28 rain gauge stations from 1971-2010 are used for analysis and hydrographs are prepared. The sub basin wise analysis is carried out, for the period 1971-1999 before introducing Alternate Sluice method of Irrigation and from 2000-2010, after introduction of Alternate Sluice Method of irrigation. The results indicate that there is an increase in the ground water level in the 50% of the observation wells located in the area even though the rainfall in this area is reduced in some parts.

Key words : Ground water fluctuations- -Rainfall-Alternate Sluice Method of irrigation

1.INTRODUCTION

Tamil Nadu being an agrarian State, its economy is based on agriculture. Agriculture production depends upon the availability of water resources. Since, the available surface water resources are fully harnessed, groundwater is the only alternative source for agricultural development. The occurrence of groundwater is mainly depends on geological and physiographical setting as well as on climatic conditions. Further, the degree of structural deformation and weathering of the geological formation control the distribution of groundwater both in vertical and lateral directions.

Due to increased development of groundwater in Tamil Nadu the following problems are identified Since groundwater has become a major source for irrigation, the groundwater scenario of the basin should be monitored and timely action has to be taken for ground water regulation ,management, conservation and augmentation of this natural resource. Unlike stream flows, which depend on monsoon, groundwater is very dependable even though its exploitation requires technology and energy. Accurate estimation of ground water recharge is extremely important for proper management of ground water systems. Continuous increased withdrawals from a ground water reservoir in excess of replenishable recharge may result in lowering the water table (Kumar 2008). For sustainable development of water resources, it is imperative to make a quantitative estimation of available water resources. The water table fluctuation method may be the most widely used technique for estimating recharge (RichardW.Healy.Peter G.HooK 2002).In this paper also the water table fluctuation method is used for analysis of Ground water assessment in the project area of Parambikulam Aliyar Project. The groundwater position of the Parambikulam Aliyar Project area is analysed by comparing the the groundwater position in two different periods from 1971-1999 (before introduction of Alternate sluice method of Irrigation) and 2000-2010 (After introduction of Alternate sluice method of Irrigation).

2.STUDY AREA :

2.1 Physiography

The Parambikulam Alyar Project is an Interstate water Resources Development Project carried out jointly by Tamilnadu and Kerala. The objective of the development is harnessing the waters of the Bharathapuzha,the Chalakudi and the Periyar basins for irrigation and power production in both States. Planned originally to irrigate 1,00,230ha during one season(135 days) each year ,the service area was increased by nearly 71% to 1,71,050 ha without, increasing available water resources. Consequently the PAP is able to irrigate only part of the enlarged command area. At this time ,the PAP delivers water from its reservoirs during two 135-days seasons each year irrigating two of four zones each about ¼ th of the total command during one season. The PAP (Fig 1) is the unique Project showing the symbol of interstate cooperation & unity by sharing the water. This Project is located in the Parambikulam Aliyar river basin which has undulating topography with maximum contour elevation in the plain is 300m and the maximum spot height in the plain is 385m above MSL. This Project area lies within the

coordinates of latitude between 10^{o} 10' 00"N to 10^{o} 57'20"N and longitude between 76^{o}43'00"Eto77^{o}30"00'E.

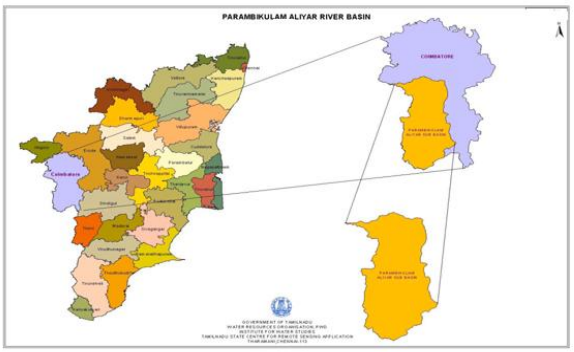


Fig 1 Location map

Parambikulam Aliyar Project includes eight reservoirs 1.Upper Nirar weir, 2. Lower Nirar dam, 3.Sholayar dam, 4. Parambikulam dam ,5.Thunakadavu damand 6. Peruvaripallam dam 7.Aliyar and 8 Thirumurthy dam. Among, the first 6 dams are located in the higher altitudes of the Anamalai Hill ranges, and the last 2 dams

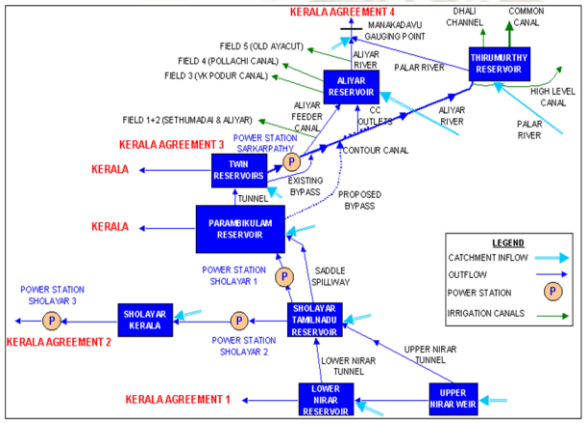


Fig-2 Flow diagram of Reservoirs

are located in the plains (Fig 2) The irrigation canals take off and utilize the storages behind these dams to serve the command area. In this project the supply of water for irrigation is only through two dams Aliyar and Thirumoorthy dam. The following four sub basins are covered in this project namely 1.Sholayar, 2.Palar, 3.Aliyar, 4.Valayar.

2.2.Description of the sub basins

a.Sholayar Sub basin

The Sholayar river originates from eastern slope of Western Ghats of Coimbatore District. The drainages namely the Parambikulam Aliyar,Upper Sholayar and Lower Sholayar passes through Valparai Block which has an area of about 403SqKm.This sub basin is covered with high hills and dense forest cover. The predominant type of rock found in this sub basin is crystalline rocks of Archean age.

b.Palar Sub basin

River Palar originates in the eastern slope of Western Ghats from Anamalai hills and passes through Gudimangalam,Pollachi,Udumalpet blocks.The soil in this area is pediment, pediment with block cotton soil and shallow pediments. The area of the Sub basin is 475Sq km.

c.Aliyar Sub basin

Aliyar river originates from Anamalai hills and passes through Kottur village and joins at Aliyar Reservoir of Coimbatore district. The Aliyar Reservoir is located along major lineaments.The major area present here is denudation forms such as pediment, pediment with black cotton soil and shallow pediments. The alluvial landforms such as bazadas occur along the foot hills of Anamalai Hill ranges in western Ghats. This Sub basin has an ayacut area of 402Sq km.

d.Valayar Sub basin

Valayar River originates from Thondamuthur block and passes through Madukkarai block and joins at Walaiyar reservoir in Coimbatore District.It has an area of about 846 Sqkm.the predominant rock types found in this river basin is crystalline rocks of Archean age.

2.3.Water distribution network

In this Project water distribution for Irrigation is carried out through the following canals.

TABLE 1 - Water distribution network

Name of the canal	**Ayacut in hec**
From Sarkarpathy Power House	
Aliyar feeder Canal	1889
Sethumadai Canal	2042
From Aliyar Reservoir	
Pollachi Canal	9509
Vettaikaran pudur Canal	4525
Aliyar Old Channels	2576
Total ayacut of Aliyar sub basin	**17965**
From Thirumoorthy Dam	
Parambikulam Main Canal,High level Canal, Udumalpet Canal	152693
Dhali Channels	1245
Total ayacut in Palar sub basin	**156514**
Total Ayacut	**174479**

The initial cropping pattern was to grow dry crops in 80% of the above command area and wet crops in 20% of the command area which was estimated to be lying in the valley bottoms. The duty @120 acres/cusec for dry crops and @60 acres/cusec for wet crops with transmission loss of 10% is adopted for the calculation of water requirement.

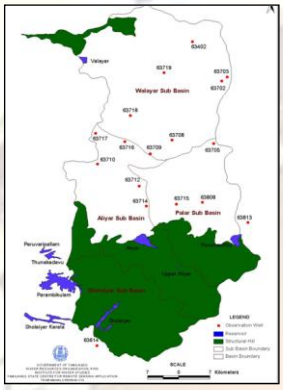
In Vetttaikaran Pudur canal and Pollachi Canal the ayacut area is divided in to two zones namely A & B and the water is supplied in the pattern A,B in one year and B,A in the consecutive year. Water is supplied to Aliyar Feeder

Canal, Sethumadai Canal by considering both as one canal system .

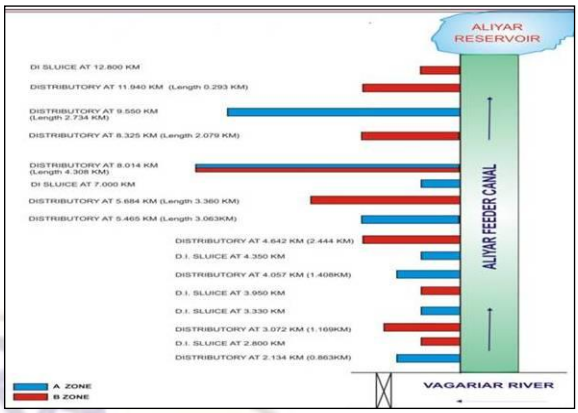
In Parambikulam main canal , the total ayacut area of 1,56,514 hectare under this canal is divided in to four zones and supply of water to each zone is once in two years for 4½ months in rotation basis.

3. NECESSITY FOR THE STUDY

The reservoirs in the Parambikulam Aliyar Project started in the year 1960 and came into operation one by one from 1971 onwards. All the Reservoirs in this project become to function from the year 1982. In the initial project period PAP is able to irrigate its total command area of 1,00,230 ha. But due to addition of ayacut area, the total ayacut of PAP increased to 1,71,050 ha and it was able to supply water to ¼ th of its command area. Hence the ayacut under Aliyar was divided into two zones A & B and under Thirumoorthy dam was divided into four zones and supply of water from Aliyar for 135 days in a year to irrigate either A or B zone and from Thirumoorthy dam two 135 days in year for two zones in a year was followed from the year 1994-95.



The above pattern was followed up to the year 2000. But in the above pattern of distribution, even though water runs in the main canal for 9 months in a year, some of the branch canals and distributaries remain dry for a long period except during supply through them . Hence the ground water recharge in these areas is not possible. Moreover the ground water is also extracted for agriculture purpose during non irrigation period by the farmers. Hence the groundwater depletion is more in these areas. This leads the farmers to represent ,for a change the distribution pattern. Based on the representation of farmers, the Government constituted a High Level Committee in the year 1999 to analyze the representation of the Farmers. Based on the Committee's recommendations, the ayacut under the canals, distributaries are regrouped into pockets (Fig 3a &Fig 3b) , and it has been decided to supply water to the alternate pockets under the new pattern of Alternate Sluice System of irrigation on experimental



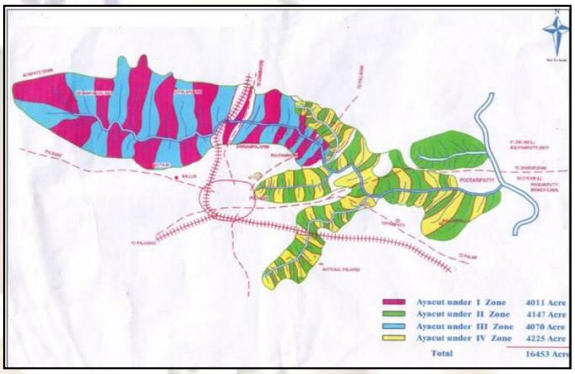


Fig 3a Grouping of ayacut in Aliyar Sub basin
Fig 3b Grouping of ayacut in Palar Sub basin

basis. It has also recommended that the working of the revised pattern of irrigation in the Project command may be observed for a period of four or five cycles and modification needed if any shall be studied.

Now it is important to study the ground water status due to regrouping of the ayacut and Command area pattern in Thirumoorthy dam supply of water through alternate sluices/Pockets , since five cycles were completed after implementation of the above alternate sluices pattern of irrigation. Sub basin wise ground water analysis is taken for the study.

4.DATA COLLECTED AND METHODOLOGY

Generally the ground water appraisal is based on geological evaluation and observation wells. The well hydrograph is the graphical representation of the water table dynamics(Sinha et al 2006). The dependency of ground water is raising day by day. The ground water gets recharged mainly through rainfall. For this study 17 Observation wells(Fig 4) located in this project area, maintained by the Ground water wing of Public Works Department are selected. These Observation wells are spread over the entire Basin area.

The monthly water level data are collected for a period 1971-2010 for all the observation wells. Sub basin wise ground water level fluctuations were studied. The comparative hydrograph showing the water level fluctuations against the annual rainfall for the period 1971-1999 and 2000-2010 is drawn for all 17 observation wells

Then the variation in water level due to implementation of Alternate Sluice pattern of irrigation is studied by comparing the hydrograph developed using the

data during 1971- 1999, with the hydrograph developed using the data during 2000 - 2010. Charts are prepared for 17 observation wells and the results were analyzed. The fluctuations are analyzed using the long term . hydrographs (1971-2010) in respect of all observation wells .

Ground water is the main source of irrigation in this project areas except during the period in which they get surface water that is once in two years for 4 ½ years.. The irrigation wells in the study area are broadly grouped as dug wells, dug-cum-bore wells and shallow bore wells. The groundwater extraction is worked out based on the cropping pattern and the existing number of wells and their categories. The rate and level of recharge depends upon the geological ,geomorphological and soil conditions in the particular area. So comparison is also made between rainfall and ground water level.

5.RESULTS

5.1 Sub basinwise Groundwater status

The ground water level of the 17 observation wells are analysed and the results are shown in sample Fig 5a,5b,5c,5d and Table 6. The trend of ground water level from the year 1999 onwards is increasing in 9 observation wells. And only in 3 observation wells there is an decreasing trend of ground water level is seen. The decreasing trend is mostly seen in the blocks mostly described as over exploited blocks and the development of ground water should be completely stopped in those areas . Other wise the ground water will be exhausted in those areas, the quality of the ground water will become worst and become environment threat.

TABLE 6 - Comparison of status of GWL & RF between 1971-99 & 2000-2010

Sl No	Name of sub basin	Total	No of wells				Annual Rainfall
			Increase in GWL	Max %	Decrease in GWL	Max %	
1	Valayar	7	4	(+)35	3	(-)8	(-)16%
2	Aliyar	5	3	(+)35	2	(-)20	(+)11%
3	Palar	4	2	(+)28	2	(-)36	(+)2%
4	Sholayar	1	0	0	1	(-)7	(+)9%
	Total	17	9		8		

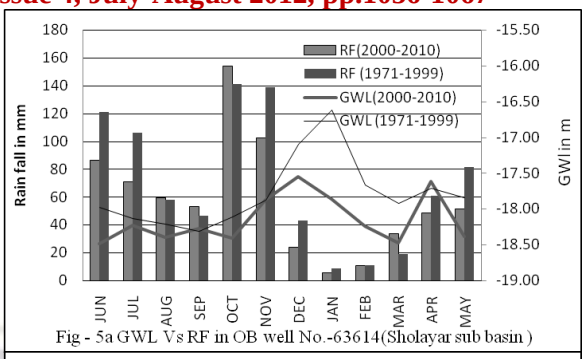


Fig - 5a GWL Vs RF in OB well No.-63614(Sholayar sub basin)

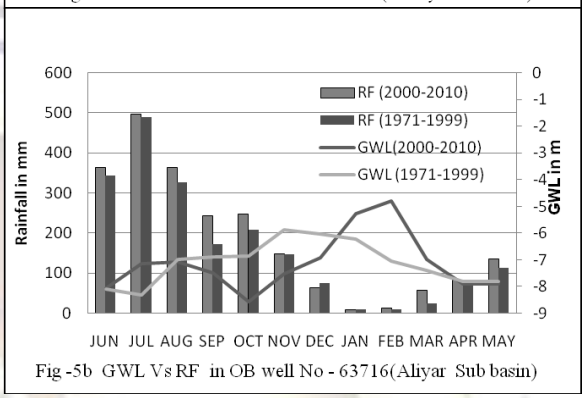


Fig -5b GWL Vs RF in OB well No - 63716(Aliyar Sub basin)

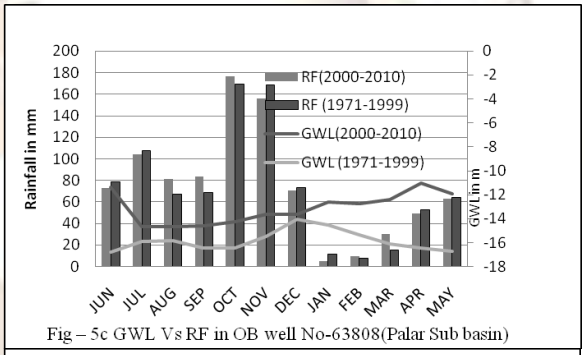


Fig – 5c GWL Vs RF in OB well No-63808(Palar Sub basin)

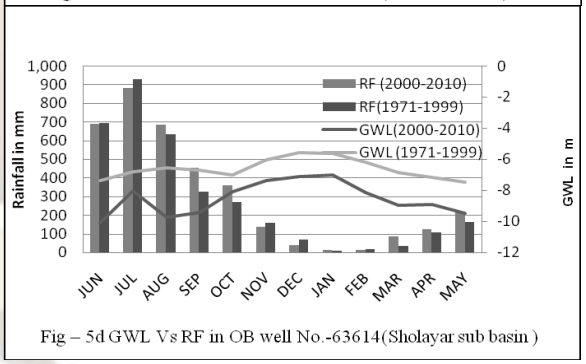


Fig – 5d GWL Vs RF in OB well No.-63614(Sholayar sub basin)

5.2 Rainfall Variation

Rainfall is not uniform throughout the study area. It depends upon spatial and temporal variations. The study area experiences four seasons namely ,Winter season(January&February),Summer season(March,April and May),South west monsoon(June,July,August and September and North East Monsoon(October, November and December).There are about 28 rain gauges available in this study area. The influence of the raingauge is selected based

on the Thiessan polygon method. The weightage for each rain gauge in the sub basin is given based on the area covered. The year wise annual rainfall is calculated from 1971-2010and corresponding groundwater level also marked.The samples are shown in Fig 6a,6b,6c &6d. The sub basin wise monthly rainfall for the period 1971-1999 is compared with the period 2000-2010.

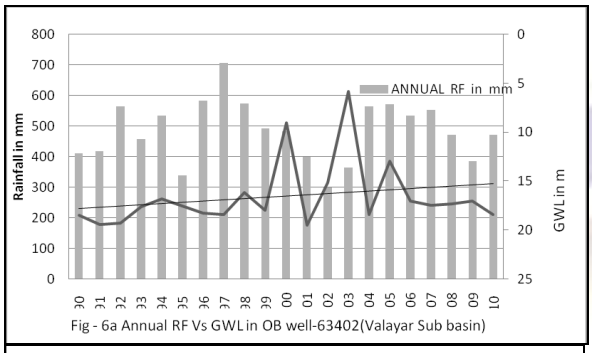


Fig - 6a Annual RF Vs GWL in OB well-63402(Valayar Sub basin)

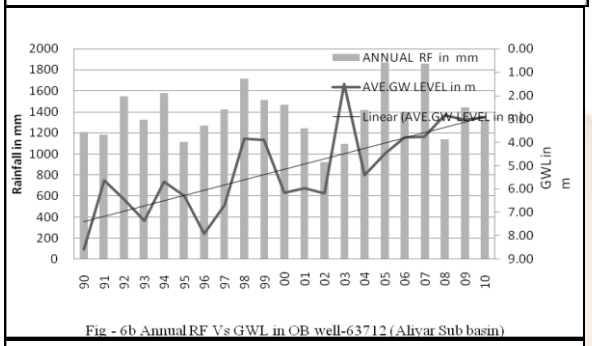


Fig - 6b Annual RF Vs GWL in OB well-63712 (Aliyar Sub basin)

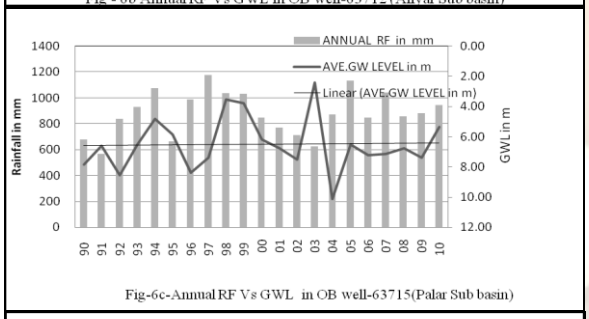


Fig-6c-Annual RF Vs GWL in OB well-63715(Palar Sub basin)

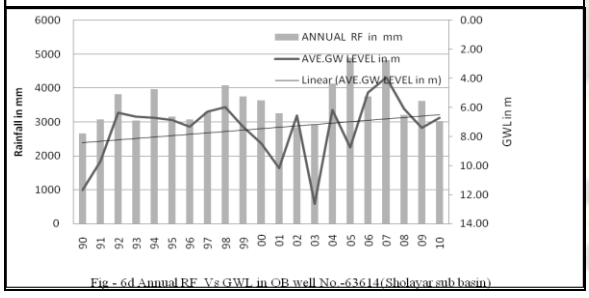


Fig - 6d Annual RF Vs GWL in OB well No.-63614(Sholayar sub basin)

6.DISCUSSION

Overall increase of groundwater level is observed in 50% of the wells..Maximum percentage of increase in groundwater level is around 35% in Valayar, Aliyar and 28% in Sholayar Sub basins. Considerable rise in the groundwater level is observed in 9 number of observation wells out of 17 observation wells selected for the period 1999-2010 to a maximum level of 1.69m.The sub basin wise rainfall details are analysed. From the analysis , the following inferences are derived. During the period of last 10 years Aliyar sub basin received 11% higher rainfall ,Palar Sub basin 2% higher rainfall, Sholayar sub basin 9% higher rainfall when compared the average rainfall for the period 1971 - 1999 with the average rainfall for the period 2000-2010. In Valayar sub basin, the decrease in rainfall is about 16%when the rainfall in the period 1971-1999 is compared with the rainfall for the period 2000-2010.

During Monsoon season also the sub basins,such as Aliyar,Palar and Sholayar received higher rainfall in the past 10 years. Increasing trend of ground water level is noticed in 14 observation wells out of 17 observation wells.The decrease in water level is noted in the 8 wells.The wells with status of decrease in ground water level are located in the blocks ,Vadavalli ,Kinathukadavu,Pollachi South, Pollachi North, Anamalai and Madukarai. Ground water development is reduced in 6 out of 10 blocks in this Project area and the Ground water status of the 6 blocks have been improved.

7.CONCLUSION

Present study is to evaluate the new method of irrigation introduced in this Sub basin at the end of year 1999. The increase in ground water levels in the 50 % of the selected observation wells is mainly due the recharge of ground water. The recharge of the ground water is mainly due to seepage of irrigated water from the agriculture field. In this project a particular field is eligible to receive water for irrigation once in 2 years. But due to the introduction of Alternate Sluice method of irrigation and grouping of ayacut in pockets for example if a field say ‘A’ and ‘C’ receive water in the current year. Then the field adjacent to ‘A’ and ‘C’ say ‘B’ and ‘D’ will receive water in the next year. Hence the excess water from the irrigated field ‘A’ and ‘C’ will seep through the adjacent field and will improve the ground water during particular year, And in the next year due to irrigating the field ‘B’ and ‘D’ the water will seep to the adjacent area A&C and improve the ground water level .Ultimate result the ground water in the whole area will be improved. Decrease in the Ground water development has improved the status of the ground water position of the various blocks located in this Sub Basin. Decrease in the ground water level in the balance observation wells are mainly due to Over exploitation of ground water, and reduction in rainfall. The observation wells located in the area, already Over- exploited , shows the decrease in the Ground water level. This study indicates that ground water development should be strictly prohibited in these areas.

The results shows that there is a maximum of 35 % of recharge of ground water takes place due to adoption of the new method of irrigation. Hence this method may be continued in future. This method is suitable in the places where the supply of water is once after more than a year. Even though this method require more water for irrigation, it is viable for environment. This is essential for maintaining the social betterment. Groundwater exploitation should be such that protection from depletion is provided, protection from pollution is provided, negative ecological effects are

reduced to a minimum and economic efficiency of exploitation is attained.(Kumar.C.P Dec2008)

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