ENHANCING SUSTAINABLE IRRIGATION FOR PISTACHIO FARMS IN IRAN'S TROPICS

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Abstract

Iran stood first both in production and export of Pistachio in the world. Availability of quality water has been basically reported as a chief hindrance in Iran's agriculture. This study was aimed to overview, the agricultural water availability, water salinity, irrigation sources and irrigation systems .The study was performed by interviewing 200 sample respondents which were selected through a multi-stage random sampling technique in Kerman Province (Iran) in 2003–2004.The results revealed that 70 percent of farmers had agricultural water limitation, 82 percent were utilizing the non-quality water with salinity degree above 5 Milimoss. For 94 percent of the sample farms, water were extracted from Deep-bore wells and lastly 97 percent of farms were managing under traditional irrigation systems, popularly called flood irrigation. All the above mentioned results show that pistachio farming is running under an un-sustainable environment This is a serious alarming not only now but also in years to come, for both Pistachio orchard owners and the government as well.

Key words: institutions, irrigation systems, productivity, sustainability, use efficiency, water extraction

INTRODUCTION

Pistachio is cultivated in Iran's dry zones accompanied with a low rainfall. Average rainfall in pistachio cultivation areas has been reported less than 150 mm/year against 250 mm/year for the whole country (IPRI, 2003). In such areas it is not possible to produce other commodities economically due to water limitation and marginal climatic condition. In these places Temperature fluctuate between –20 to 45°C during farming year (Sedaghat, 1997).

Farmers are using flood irrigation system as a dominate system in Pistachio gardens. According to the reports using this system entails farmers to consume 9 000 m^3/hectare/year of water with the use efficiency of only 30 percent. Instead using new irrigation systems, the water requirement declines to only 5 500 m^3/hectare/year which 38 percent incensement of water use efficiency (IPRI, 2003). According to the data from FAOSTAT Information Bank, Iran accounted for 52.89, 58.00, 64.79, and 65.84 percent of Pistachio world production, cultivated area, export and export value, respectively during the last decade (Sedaghat, 2006).

Despite the existing prominent role of the crop in income and employment generation, the future seems bleak owing to an alarming situation in under ground water availability, that in turn negatively affected the produc-tivity/profitability of Pistachio farms (Sedaghat, 2002).

The core objective of this paper is to study the sustainable utilization of underground water in the region and to provide a guideline/policy implication towards long run water conservation as well.

Water property rights

Ground water utilization is one aspect of general problem of the common property resource .Since the right of percolating water are normally obtained only by "**capture**" , pampers have an incentive to withdraw water at a rate greater than would otherwise be rational for the fear that the withdrawals of others will lower water levels in their own well. As on one has property rights that are valid in the future, individuals are not encouraged to maximize the present value of total extractions over time. While economists have recognized that failure to maximize income over time will cause a serious misallocation of resource and have suggested approaches to an optimal use of ground water (Chaitra and Chandrakanth, 2002).

Transaction costs, Institutional/organizational structure in the context of common property rights

Transaction cost is defined as the cost of making and enforcing decision. It includes the cost of obtaining information, establishing one's bargaining position, arriving at a group decision and enforcing the decision made (Sripadmini et al., 2001).

According to Coase, although the gains which accrue from the existence of the organization come from a reduction in transaction costs, the main transaction costs that are saved are those which would otherwise have been incurred in market transactions between the factors, now cooperating within the organization and the organizers. He further explains that these factors include both people and things that agree to obey the directions of the organization's organizer for remuneration (Sripadmini et al., 2001).

Individuals or groups innovate institutions in order to reduce the transaction costs In the context of CPRs (Common Property Rights) collective action outcomes would be preferred when the expected returns are larger than the costs of coordinating collective action. Further, imperfect information could block an appropriate institutional arrangement or could lead to degeneration of an appropriate institutional arrangement. Therefore, information is a necessary but not a sufficient condition to explain institutional change in the context of CPRs where collective action is a prerequisite for institutional arrangements (Ratna Reddy, 2000).

MATERIALS AND METHODS

Primary data was collected using a multi stage random sampling technique in Rafsanjan city (Iran) in 2003–2004 .In the first stage, 40 villages and in the second stage 200 sample farmers were selected randomly based on the farmers' population of each sample village.
Secondary data were also used as complementary information. Data were analyzed based on theoretical concepts concerning common property rights, institutional structure, transaction cost and also by adopting some descriptive statistics like mean and percentages using EXCEL software.

RESULTS AND DISCUSSION

The source of irrigation investigated and is shown in Table 1.ninethy four percent of farmers were using deep-bore well for the irrigation purpose against only 6 percent, who were using the semi deep – bore well in the study area.
Water extraction is very costly due to high depth of the Irrigation wells. Due to over extraction of underground water and rainfall shortages in the region, irrigation costs tend to increase more and more.
The existing irrigation systems were studied and results are shown in Table 2.Ninety seven percent of sample farmers were using the traditional system that is called flood irrigation against three percent using traditional-cum-modernized systems.
Although Iranian government has paid huge amount of discounted loans and credits, but still farmers were not going to adopt new irrigation systems. The main reason behind, is that farmers look at underground water as a common property resource which investing on, and benefits other farmers without any payment.
The salinity of water was studied and result is shown in Table 3. The average salinity degree was 8.36. Eighteen percent of farms had water with salinity below 5 Milimoss. Fifty seven percent with salinity ranged between 5–10 Milimoss. Twenty three percent with salinity degree ranging between 10–15 Milimoss and only 2 percent had water with salinity degree varied from 15–20 Milimoss.
The study of water salinity of the sample farms confirmed that 82 percent of sample farms were using salty water with salinity degree between 5–20 Milimoss which is not preferred for production of any other agricultural crop except Pistachio due to high resistance of this crop to water stresses.

Tab. 1: Irrigation sources of sample farms in each district and overall (numbers)

Source	District					
	Anar	Kohekohe	Esmaeelabad	Bahraman	Kabootarkhan	overall
Deep-Bore well	18 (90)	20 (100)	19 (95)	20 (100)	17 (85)	94 (94)
Semi deep-Bore well	2 (10)	–	1 (5)	–	3 (15)	6 (6)
Total	20 (100)	20 (100)	20 (100)	20 (100)	20 (100)	100 (100)

Note: Figures in parentheses are percentages to respective totals

Tab. 2: Details of Irrigation systems used by sample farmers in Kerman province, Iran (numbers)

Irrigation system	District					
	Anar	Koshkooye	Esmaeelabad	Bahraman	Kabootarkhan	overall
Traditional	20 (100)	20 (100)	20 (100)	18 (90)	19 (95)	97 (97)
Modernized (under pressure)	–	–	–	–	–	–
Both systems	–	–	–	2 (10)	1 (5)	3 (3)
Total	20 (100)	20 (100)	20 (100)	20 (100)	20 (100)	100 (100)

Note: Figures in parentheses are percentages to respective totals

The availability of irrigation in the study area was studied and results are shown in Table 4. Among sample respondents, 30 percent had availability in whole year but forty four percent had non-availability during summer, 4 percent in autumn and 22 percent during the entire year. Availability of water overview revealed that 70 percent of farmers faced serious shortage of water. Sixty six percent of farmers had water shortage in summer and in whole year. According to horticulturists, the limitation of water in summer will negatively affect the productivity of gardens.

Major hindrances toward sustainable irrigation in Iran

There are some bottlenecks which prevented farmers from utilizing underground water efficiently and sustainable. They also made a permanent failure in government water polices during the past years in Iran. Unclarified property right for underground water resources, improper distance between wells belonged to individual farmers/groups, unavailability of agricultural water NGOs/Associations, lack of proper rules/laws on irrigation, traditional mode of charging farmers for utilized water based on the number of wells, individual's unawareness about water sustainability and optimal utilization, information/supports lack on new irrigation systems both pre-post implementation supports.

CONCLUSION

The Irrigation overview of sample farms showed an unsatisfactory situation in the region. Ninety four percent of farmers were using only Deep-bore wells. Ninety seven percents were following a traditional system which is called flood Irrigation. The salinity degree of water was very high affecting negatively Pistachio productivity. Water was a restriction for most of the farmers especially in the peak seasons. The above mentioned shortcomings entailed farmers a high cost of water extraction, low water usage efficiency and low productivity of produce that inurn, affected the farm profitability in recent years. To achieve a certain level of profitability farmers were compelled to put a high pressure by extracting more and more underground water which is a serious alarm both in current period and also years to come. So there is an urgent need for increasing water efficiency, productivity per unit of water extracted and decreasing the water usage costs through proper policies/ packages.

Tab. 3: Water salinity of sample farms in each district and overall (number)

Salinity (Milimoss)	Districts					
	Anar	Koshkooye	Esmaeelabad	Bahraman	Kabootarkhan	overall
Up to 5	3 (15)	12 (60)	1 (5)	1 (5)	1 (5)	18 (18)
5–10	9 (45)	7 (35)	14 (70)	13 (65)	14 (70)	57 (57)
10–15	6 (30)	1 (5)	5 (25)	6 (30)	5 (25)	23 (23)
15–20	2 (10)	–	–	–	–	2 (2)
Average salinity degree	9.73	5.17	7.84	10.23	8.85	8.36

Note: Figures in parentheses are percentages to respective totals

Tab. 4: Availability of irrigation of sample farms in each district and overall (numbers)

Seasonal availability	District					
	Anar	Koshkooye	Esmaeelabad	Bahraman	Kabootarkhan	overall
Available in whole year	3 (15)	9 (45)	7 (35)	5 (25)	6 (30)	30 (30)
Not available in spring	–	–	–	–	–	–
Not available in Summer	8 (40)	9 (45)	8 (40)	9 (45)	10 (50)	44 (44)
Not available in Autumn	–	–	2 (10)	1 (5)	1 (5)	4 (4)
Not available in winter	–	–	–	–	–	–
Not available in whole year	9 (45)	2 (10)	3 (15)	5 (25)	3 (15)	22 (22)
Total	20 (100)	20 (100)	20 100)	20 (100)	20 (100)	100 (100)

Note: Figures in parentheses are percentages to respective totals

There are two well known way for alleviation (reduction restrictions generally named Demand side versus supply side water management. Supply management refers to all policies) activities that lead to increasment in water resources stock, like watershed management projects.
Due to rainfall shortcoming in the region there is not much scope for increasing the water resources stock.
As water resources are a type of common property resources, property rights are not clearly assigned to each and every individual but they can be assigned for groups of individuals. Hence it is expected that farmers don't show any interest to participate in such projects individually against a possibility of groups participation .So it is suggested to encourage individuals to establish water institutions which should be supported with complementary laws/training programs.
Users willingness to participate is not quite enough to compensate all the costs associated with such projects which are naturally capital intensive. Hence government should take the responsibility of funding/enrolling such projects to bring sustainability in agricultural water resources an also to assure equity among people in the society.
The widely accepted and adopted method in absorbing private participation is based on willingness to pay. So, to increase farmers' willingness to pay, necessary information should be provided by government/ institutions. Here farmer institutions can play a major role in enhancing farmers' honest participation and commitment in many aspects.
Water demand management refers to all kind of policies/activities which result in optimal allocation of water and increasing use efficiency. Due to the nature of common property resources, there should not be expected a high tendency from individuals in generating optimal allocation or increasing the water use efficiency. Here to absorb the individual participation mainly in adopting new technologies/systems and the laws concerned, the main role should be given to the institutions made by individuals. But it is also a main role for government here to provide appropriate structure, policy context, laws and services to the farmers and water institutions/NGOs.
More over the transaction costs associated with institutions/organizations can be charged from participants. The widely accepted and practiced method is to charge individuals based on the unit of water utilized / the unit of electricity used. If farmers charged in this way, there is expected that, they continue to extract water and use it efficiently. Also charged amount can be used as a framer's participation source in any other kind of irrigation projects that may be needed. Most importantly, there should be a clear bill of collected and expended amounts to the farmers every year to enhance their honest participation in such schemes in the long period.
Finally, as it is expected, there may be some individuals who are not participating in such schemes/institutions, so it is suggested to enroll a discrimination pattern between them and those who are participating honestly, for that, participants may be charged in a lower rate than non-participants.

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