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UNIVERSITY OF TEHRAN

**WATER, ECOSYSTEMS AND SUSTAINABLE
DEVELOPMENT IN ARID AND SEMI-ARID ZONES**

**EAU, ECOSYSTÈMES ET DÉVELOPPEMENT
DURABLE EN ZONES ARIDE ET SEMI-ARIDE**

ABSTRACTS

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of the dam during the construction and operation of the hydro electric dam. Environmental Management, Monitoring and mitigation of negative environmental impacts were analyzed.

Key words: Gotvand Hydro Electric Dam, EIA, ICOLD and Leopold matrices

WORSHIP OF WATER THROUGH OLD IRANIAN TEXTS: AVESTA HYMNS, INSCRIPTIONS AND PEHLEVI TEXTS

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Worship and reverence to Water has a long history among ancient Iranians. According to documents praising, water was done throughout Persia beside springs flowing from mountains and rivers and lakes which were natural places of worship. Respect to that increased so that not only they erected religious sculptures with the name of "Goddess of waters" in different parts of the country but the poems sang in her description mentioned as "Aban Yasht" (Worship of water) in the Avesta.

Goddess of waters in texts of Avesta is followed with adjectives as Anahita (pure), and Sura (powerful), for Aredvi (wet, humid), a sacred river. Incarnation of Anahita in Aban Yasht is praised as a young, pretty and broad-minded lady ornamented with jewels, as a symbol of forgiving productivity, fertility and abundance. The Almighty Ahuramazda created the Goddess of his own power so that she preserves homes and country, devastates evils, develops the world, makes happiness for people and breeds beasts, as she is the source of all physical developments and progresses and without her the world would be dark and painful. Increase of cattle and flock, wealth and affluent comes from her. And she has a spiritual relationship with wisdom.

Ardvisur River is as big as all waters and strongly flows from Huger Peak into Vorukasha Sea. Many mythical heroes, kings and nobles give gifts to the river and scarify for it in order to gain victory. The river fulfils the demands of all, except of Ajidahaka, Bad Din and wicked Afrasiab, those who were deprived of favor and did not meet their wishes.

In the inscriptions of Achaemenians (Artaxerxes II and later) they ask "Anahita" to help them, and temples were built to worship her e.g. in Estakhr. In some Sassanian inscriptions the name of Anahita is mentioned and her portrait is shown in relief of the Sassanid kings, those who are taking investiture from this "Persian Lady".

In Pehlevi and Zend texts Aredvisur is an incarnation of a mythical river and Anahid is the Goddess of fertility. In the great Bundahishn is said that Ardvisur is the source of all rivers and seas of the world.

All these documents clearly prove the importance and admiration of Anahita among ancient Iranian people.

Key words: Worship of water, Aredvisur Anahita, Avesta, Aban Yasht, Achaemenians inscriptions, Pehlevi texts

EFFICIENCY OF SUB-SURFACE IRRIGATION IN PISTACHIO USING PRICKED-PIPE COVERED WITH PLASTIC CLOTH IN ARID ZONES

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Irrigation water quantity and quality limitations is the main problem of agricultural development in most of the arid and semi-arid regions of Iran including the area selected for this research project (Rafsanjan Pistachio orchards). This research project was designed to compare the applicability of two different types of irrigations systems including surface irrigation (which is traditionally used by local farmers) and sub-surface irrigation using pricked-pipe covered with plastic cloth (as a new method in this region). For this purpose two plots each one containing 48 pistachio trees and about 720 m² area were selected in an orchard and were hydrologically isolated from each other and the other parts of the orchard. It should be added that trees in both plots were quite similar in terms of age, canopy and stem size and diameter as well as the outward appearance. One of the plots was prepared for surface irrigation and the other plot for sub-surface irrigation. Both plots were irrigated using exactly equal quantity and quality of water for 2 years.

At the end of the second year, the yield in plots was harvested separately and the wet and dry crop weights of crop harvested in each plot was measured. As it is seen, the weight of wet and dried crop in sub-surface irrigation plot to those of surface irrigation plot is respectively 1.895 and 2. In addition, the mean weight of each pistachio produced in surface irrigation plot was 0.6341 gr. where it was 0.7082 gr. in sub-surface irrigation plot. Another parameter measured for the trees of two plots was the annual shoot growth.

To do this, a Plot Growing Index (PGI) was calculated for each plot. The value of this index was 2 237.5 cm in surface irrigation plot where in sub-surface irrigation plot it was 4 580.5 cm. In fact, PGI in sub-surface irrigation plot to PGI in surface irrigation plot was 2.05. Last measured parameter was the dry weight of weed growth in each plot. At the end of second growing season, the dry weight of weed in surface irrigation plot was 82 kg where it was only 21 kg in sub-surface irrigation plot. The results of soil samples analysis show no considerable variation in PH, EC, occurred in the plots during the research period.

According to the results taken from this research, the difference in efficiency of two irrigation systems is considerable in this area. Therefore, in the area where the irrigation water shortage is the main issue, surface irrigation system, which is traditionally used by farmers, is not an efficient method as the main part of water is lost due to high evaporation rate during the irrigation and after it. Groundwater recession in this area and the serious water limitation for pistachio orchards (which almost is the

only crop for local farmers) necessitates optimization of irrigation systems toward new systems with minimum water loose such as sub-surface irrigation.

Key words: Sub-surface irrigation, Irrigation efficiency, Water use efficiency, Arid lands irrigation, Pistachio orchards, Dry lands environment, Agricultural water use

MAN, WATER AND ENVIRONMENT: THE SUCCESSIVE STAGES OF THE KERIYA RIVER DELTAS

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Since 1991, the Sino-French archaeological Mission in Xinjiang investigates the KERIYA valley (Yutian) in Southern Xinjiang, an endoreic river which springs from Kunlun Mountains and connected formerly the oases of the South to those of the North of Taklamakan.

Objectives: 1/ to test the hypothesis of the existence of ancient agrarian settlements in the desert, on deltas and along ancient channels nowadays totally dried of this river, the various states of which are visible on the satellite images. 2/ to clarify settlement patterns on the long term by replacing them in the evolution of their environment under the influence of natural or anthropic factors (desertification, movement of river beds and deltas, evolution of oases).

Methods: to study the modalities of occupation and development of territories by localizing archaeological sites in connection with the ancient river systems mapped by remote-sensing, and by making archaeological excavations to collect data (artefacts and ecofacts) on the evolution of the agricultural, economic, and cultural practices (types of culture and irrigation, domestication and uses of animal and vegetable species, settled way of life and nomadism, etc.).

Results: from the current bed of the Keriya River to its fossil courses, several years of excavations, surveys and pluridisciplinary studies allowed us to reach these objectives and to restore an evolution in at least three times of the successive deltas of the Keriya River: protohistoric (2nd-1st mill. BC: Bronze and Iron Ages), antique (3rd-4th c.), current.

These successive deltas, spread out in the space, correspond to various stages of desertification. In each of them, an oasis and a vast zone of populating is centred on a main village. The comparison of settlements between them and with Central Asia allows to draw up an inventory of the interactions between man/water/environment and to bring out constants and variables of change.

Key words: Keriya (P.R. China), Settlement pattern, Geoarchaeology, Irrigation, Desertification, GIS

LA KERIYA DANS TOUS SES ÉTATS : MODES DE PEUPLEMENT ET PALÉOENVIRONNEMENTS

Depuis 1991, la Mission archéologique franco-chinoise au Xinjiang explore la vallée de la Keriya (Yutian) au Xinjiang méridional, une rivière endoréique qui prend sa source dans les Kunlun et reliait autrefois les oasis du sud à celles du nord du Taklamakan.

Objectifs : 1/ tester l'hypothèse de l'existence de peuplements agricoles anciens dans le désert, sur les deltas et le long d'anciens cours aujourd'hui asséchés de cette rivière dont les différents états sont visibles sur les images satellitaires. 2/ élucider les mécanismes de ces peuplements en les replaçant dans l'évolution de leur environnement sous l'effet de facteurs naturels ou anthropiques (désertification, déplacement des cours et des deltas, évolution des oasis) sur le long terme.

Méthodes : étudier les différentes modalités d'occupation et de mise en valeur des territoires par la localisation des sites archéologiques en relation avec le réseau hydrographique ancien cartographié par télédétection et la collecte en fouille de données (artefacts et écofacts) sur l'évolution des pratiques agricoles, économiques et culturelles (mode de culture et d'irrigation, domestication et utilisation des espèces animales et végétales, sédentarité et nomadisme, etc.).

Résultats : du cours actuel de la Keriya à ses cours fossiles, plusieurs années de fouilles, de prospection et d'études pluridisciplinaires nous ont permis d'atteindre ces objectifs et de restituer une évolution, en au moins trois temps, des deltas successifs de la Keriya : protohistorique (2^e-1^{er} mill. BC, âge du Bronze, âge du fer), antique (III^e-IV^e s.), actuel. Ces deltas successifs, échelonnés dans l'espace, correspondent à différents stades de désertification. Dans chacun d'eux, une oasis et une vaste zone de peuplement est centrée sur une cité ou une bourgade principale. La comparaison de ces occupations entre elles et avec l'Asie centrale permet de dresser un état des interactions entre homme/eau/milieu et de dégager des constantes et des variables de changement.

Mots-clés : Keriya (R.P. Chine), mode de peuplement, géo-archéologie, irrigation, désertification, SIG

WATER QUALITY AND RESERVOIR MANAGEMENT IN THE BRAZILIAN SEMI-ARID

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Most of the Brazilian northeastern region, with an area of 900 000 km², is a drought-prone semi-arid environment. Rainfall is concentrated in about 3 to 6 months, with high temporal and spatial variability. Groundwater availability, mostly from crystalline-rock aquifers, is low. Therefore, the construction of surface reservoirs has been a traditional way of coping with the hydro-climatic variability. However,