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**IMPACT OF TECHNOLOGY ON TRADITIONAL IRRIGATION SYSTEM IN
BALOCHISTAN: WORLD SYSTEM ANALYSIS IN ANTHROPOLOGICAL
PERSPECTIVE**

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ABSTRACT

This paper deals with the traditional and modern irrigation system in Zandra Village, District Ziarat, in the Province of Baluchistan, Pakistan. Zandra Village is situated 108 km southeast of Quetta, just 12 km short of Ziarat town. This village is famous for apple production. In this article development of irrigation system from traditional to the modern has been discussed. Traditional system includes centuries old karezes and bowaries (wells) which are relatively recent development whereas the modern includes latest tube-wells. Structure and construction of ZandraKarez have also been discussed in detail. Impact of modern technology has been analyzed in light of world system theory at micro level.

Keywords: Bowaries, core countries, karez, peripheral well, countries, semi-peripheral countries, shaft, tunnels, world's capitalist economies, development

INTRODUCTION

The present study was conducted in Zandra village situated in District Ziarat, in Baluchistan, the largest province of Pakistan. Baluchistan shares its northern border with Afghanistan with major cities of Chagai, Quetta and Zhob. The western border is shared with Iran via districts Makran and Kharan. The eastern end is bounded by the Sind province, whereas the Arabian Sea lies on its south.

Zandra Village is situated 108 km southeast of Quetta just 12 km short of Ziarat town. The village is 8,000 ft. above sea level and is surrounded by grey hills, apple orchards and Juniper forest, which is considered to be the 2nd largest in the world. Thus, the area is greener than other areas of the province.

The major part of Balochistan is barren due to lack of water. People use different sources to get water for irrigation (e.g. *karezes*, wells, tube-wells, streams etc.). *Karezes* are still the most important source of irrigation in different parts of Balochistan. In many areas of the province, life is not possible without *karezes*. After *karezes* there comes the number of wells and tube-wells. Some of the land is also irrigated with rainwater. In the village there are two types of irrigation systems, traditional and modern. Traditional includes *karezes* and *bowaries* (wells), whereas the tube-wells are considered as modern irrigation system which has been introduced in

certain parts of Balochistan like in village Zandra. The karez remained as the most important source irrigation for centuries but now this modern technology has reduced the importance of karezes down to certain level.

METHODS

Anthropological research methods were used for data collection. Different sampling techniques were used during the research like judgmental sampling for selecting key informants, purposive sampling for selecting 100 households using Karez water and snowball sampling to choose 30 households which switched over to modern technology. It was a longitudinal study. The first visit was conducted in 1987 which lasted for 4 months, then a couple of visits in 1990s and finally in 2007.

THEORETICAL FRAMEWORK

Main focus of this research is on world system theory. The world system approach was developed by Immanuel Wallerstein (1974²⁴, 1980²⁵ & 1989²⁶). The other contributors of world system theory are Samir Amin (1970)²⁷ (1973)²⁸, Cardoso and Falleto (1969)²⁹, Santos (1970a)³⁰ (1970b)³¹, Rodney (1974)³², and Andre Gunder Frank (1969).³³ According to Wallerstein, the capitalist world economy is a dynamic system which keeps on changing with the passage of time. However, some of the basic features remain constant. When we look into these changes the core countries are clearly the most benefited from this arrangement. They earn very high profits from international trade. They exchange manufactured products for raw materials mainly from peripheral countries and to some extent from the semi-peripheral countries. The core countries are becoming richer and richer at the cost of the peripheral economies. It does not mean that every citizen of the periphery is becoming poorer and everybody in the core countries is becoming richer as a result. The landlords in the periphery often become richer at the expense of their underpaid labor, as they can exploit them and can use their surplus manpower in their interest. In the core countries, most of the landless rural population is forced to work as wage laborers which results in a relative decline in their income and living standard. In general this theory says that the world's capitalist economies determine the route for development of the large part of the world's population in their own favor.

²⁴Wallerstein, I. (1974). *The modern world system, vol. I: Capitalist agriculture and the origins of the European world economy in the sixteenth century*. New York: Academic Press.

²⁵Wallerstein, I. (1980). *The Modern World System II: Mercantilism and the Consolidation of the European World Economy. 1600-1750*. New York: Academic Press.

²⁶Wallerstein, I. (1989). *The modern world system, vol. III: The second great expansion of the capitalist world economy 1730-1840s*. San Diego: Academic Press.

²⁷Amin, S. (1970). *L'accumulation à l'échelle mondiale; critique de la théorie du sous-développement*. Dakar: IFAN.

²⁸Amin, S. (1973). *Neo-colonialism in West Africa*. Hamondsworth, UK: Penguin.

²⁹Cardoso, F. H. & Falleto, E. (1969). *Dependencia y desarrollo en América Latina*. Mexico City: Siglo Veintiuno.

³⁰Dos Santos, T. (1970a). *Dependencia económica y cambio revolucionario*. Caracas: Nueva Izquierda.

³¹Dos Santos, T. (1970b). The Structure of Dependency. *American Economic Review*, 60(2), 231-236.

³²Rodney, W. (1974). *How Europe Underdeveloped Africa*. Washington, DC: Howard University Press.

³³Frank, G. (1969). *Capitalism and Underdevelopment in Latin America*. New York: Monthly Review Press.



In world system theory, Wallerstein explains the wide-ranging and different effects of development on the world's population. He examines how economic and political conditions in northwestern Europe transformed into the superior commercial and political power after the breakdown of feudalism. The capitalist world economy has been growing since its birth. Its geographic expansion has changed political systems as well as the labor conditions wherever it could penetrate. Functions of the world economy have created big differences and inequalities among the economies of different countries. The relationship between the core, peripheral and semi-peripheral countries are also relative inconstant. Technological development brings positive changes all over the world. Some impulsive changes are brought in peripheral or semi-peripheral countries, but the core countries get the most advantage. Wallerstein, however, after the analysis of history of the capitalist world system firmly concluded that this development has created inequality and disparities in economic and social sectors of different countries rather than bringing prosperity all over the world.

KAREZ

*Karez*es are the underground channels, which bring the water from the higher to the lower place mostly for irrigational purposes. The *karez*es are present in some other countries as well. They are known by the different names in different countries. In Iran, the *karez*es are called as *kanat* (*Qanat*). In North Africa, it is known as *Fuggaras*, in Oman its name is *Falaj*, and in Afghanistan it is called *karez*. The word *Kahan* is used for it in Makran, and in rest of Baluchistan it is known as *karez*. All these different names are performing the same functions in the different countries. A *karez* consists of three parts:

Mother-well(s): Only mother-well contains water, which is present at the head of *karez* at a higher altitude. These mother-wells could be different in number. A *kareze* can have one to ten mother-wells. In rest of the *karez*, water flows but all that is taken from mother-wells. If the number of mother-wells is more than one, then all of them are linked with each other from the bottom with the help of tunnels. All the water from different mother-wells is collected in one well from where it is taken to the fields with the help of tunnel.

Tunnel: Underground horizontal tunnel is dug to bring the water from mother-well to the ground surface. It is connected to the mother-well at the bottom. While digging a sloopy is maintained due to which, water travels down. In this system no machine is used to bring the water to the fields.

Shafts: The third essential part of the *karez* is shafts. These shafts are wells which are dug vertically at a regular distance, normally 25-30 meters, throughout the *karez*. At the bottom these are connected with tunnels. Their main function is ventilation. While digging the tunnel, mud is also taken out through these shafts. These shafts are also very useful in the cleaning and maintenance of *karez*.

In spite of the modern technology and engineering, the methods of construction and maintenance of *karez* are the same to that of hundred years ago. The people who dig the *karez* are called

karezkash, kahankash or *kannat*. In this field of digging *karez*s, Balochis are considered as the experts. They usually inherit this profession. Some Afghans are also working in this field.

Generally, a meeting is held between the *karez* diggers and the owners of the *karez* before start of construction wherein they discuss about course of the *karez*, from where the *karez* will start and where it will end, where the mother-well would be dug, who will search for water under the ground before digging, and what method would be used.

Two traditional methods are used for searching water under the ground before they start digging the mother-well. In first method, a person holds two copper wires, one in each hand. He keeps these wires close but separate from each other and starts walking on the surface of the ground. Whenever he reaches the point where there is water underground, the ends of the wires touch each other. So they come to know that there is water in the deep. Some experts can even tell its depth. The natives think that the people having a specific blood group can only make a correct guess but they do not know which blood group.

In second method of finding water, a person holds a green 'Y' shaped branch in his hands. He holds this branch from the separate ends with both hands. He keeps it in upward direction and walks on the surface of the earth. When he reaches the point where there is water underground, the upper end of the branch automatically comes down and when the water finishes it goes up again. This practice is called *abbo* (water) *shanakht* (identification). Some people call it *tajarba* (experience).

While making a *Karez* first of all a mother-well is dug. If they do not find sufficient quantity of water in that well, they keep on digging more wells until and unless they are satisfied with the quantity. After completing mother-wells, they dug 2 feet deep hole of 3 feet diameter on the other side of mother-well where the *karez* ends. This becomes the mouth of the *karez*, from where the water comes out. The owners of the *karez* often point out this place. Similar holes are also dug between the mouth and the mother-well at a distance of 25 to 30 meters each. Later these holes are further deepened to make the shafts and the leader of the group (*karez*-digger) determines the depth. The most important thing in digging these shafts is to maintain the slope of the tunnel throughout the *karez*. So the depth of each shaft keeps on increasing from mother-well towards the mouth. The expert, leader of the group, calculates the depth of each shaft. Often one shaft is $1/6^{\text{th}}$ or $1/8^{\text{th}}$ of a foot deeper than the previous one. A rope is used to dig the shafts down to an accurate depth.

The work on horizontal tunnel starts after the completion of these vertical shafts. They start digging the tunnel from the mouth towards the mother-well. A line is drawn on the surface to keep the direction right. They just keep on connecting the shafts at the bottom through the tunnel. Sometimes while digging the tunnel, the diggers come across a big stone or a rock, which they

cannot pass through. They change the direction of the tunnel and bypass the rock. This bypassing technique is called *baghalbur*, and without this work on *karez* is not possible.

Often, these *karez*-diggers work in a group comprising of four members. Two members work in underground tunnel. One of them digs the tunnel with a local made tool called as *ganti*. The other fills the mud in a bag and brings it to the bottom of shaft where he attaches it with a rope and gives a signal to the members present on the top to pull that out. Normally a pulley, locally called as *charkh*, is used for this purpose.

The mud, which comes out of the tunnel, is put around the opening of the shaft in shape of a heap to protect it from the external material, which often goes in with the wind and the floodwater, which can destroy the *karez*. This heap of mud is often visible from a distance.

A dam is made with the help of stones, iron net and cement, on the top of the *karez* near the mother-well to store rainwater flowing from the mountains. This water is absorbed by the earth and the level of water in the *karez* becomes higher. This dam also stops the floodwater, which could be harmful for the crops. The mud in the dam, which comes down from the mountains with water, is very useful for the preparation of agricultural land.

For construction of a *karez*, money is collected from the villagers and after the completion, shares are distributed accordingly. The person who gives more money gets more water. Nowadays, work on *karez* is done on contract basis. Cost of digging a shaft in soft area is Rs.80 per yard and in hard/hilly area it is Rs.500 per yard. For a tunnel it is Rs.200 and Rs.1600 per yard respectively. Shaft rates are applied in digging a mother-well, but when the water comes, digging becomes expensive i.e. 2000 rupees per yard.

Zandra Karez

Zandra Karez was constructed in the village approximately 300 years ago when the people started giving attention to agriculture. This *karez* comes down to the village from the north. Its mother-well, locally called as *chashma*, is 2 kilometers away from the main road of the village. It has only one mother-well and 36 shafts. Among these 36 shafts, 18 are new and the other 18 are old ones. The shafts in the local language are called as *saa* and the tunnel as *lamboor*. About 80 years ago the old tunnel was blocked with mud and the natives had to dig a new tunnel. Thus they had to make new shafts. Now the old tunnel and shafts are nonfunctional. The distance between each shaft is about 25 meters. The distance between first shaft and mother-well is 550 meters. The depth of the mother-well is about 30 meter. The depth of shafts varies as the village does not have a smooth earth surface.

In 1935, the government made a drain from the last shaft of the *karez* to the village. This drain brings water to a pond alongside the main road. From this pond, another drain takes the water to another pond, which is present at a distance of 200 yards from the first one. From the second pond, water is distributed to three drains in different directions within the village. These drains pass through the living area to the fields. Some people have extended boundary walls of their

houses over the drains to get water by keeping themselves inside the house, as there is no restriction on water for household use.

In 1973 the government constructed a dam at a distance of 500 meters from the mother-well on the upper side to store rainwater. The government neither took any contribution from the shareholders nor imposed any tax for this dam. A small tax was imposed by the government, called as *malia* for the drain, which is Rs.2.60 per *shanger* (three hours of karez water) per year. The government has also appointed a peon on salary for cleaning the drain. People are allowed to take mud from this dam for their lands free of cost.

The government releases funds for the *karez*s amounting to Rs.5000 to 10000 annually. This year i.e. 2007 the amount was Rs.7500. The government releases this fund to the head of Union Council through ZTBL which was previously known as Agricultural Development Bank of Pakistan (ADBP). From the head of Union Council the *mirabbs*³⁴ of *karez*s collect the amount and spend it for maintenance of the *karez*. This amount does not fulfill all the requirements so more money is collected from the people.

In 2006 the shareholders contributed Rs.300 per *shanger* (three hours of karez water) and started a project on the mother-well, which took two years to complete. They made three tunnels in the well in different directions to improve the level of water. One tunnel is 15 meters, while the other is 10 and the third one is 8 meters long. These tunnels fetch some more water to the mother well. In 2008 they were planning to make another well on top of the longest tunnel.

This *karez* needs cleaning and maintenance once in a year which is normally done in April and takes 3 to 4 days for its completion. For this purpose, labor as well as money is required. Every shareholder provides his services as labour according to his shares of water or pays money if he cannot work. This work on the *karez* by the shareholders is called *wragom* in local terminology. A person whose share is six hours (two *shangers*) of water has to work for one day. If he cannot work he may provide a person to work in his place or he has to pay money, otherwise his water could be stopped. This money is called as *nagha* and its amount is fixed by the *mirabbs* in accordance with the wages rates. By this money the *mirabbs* arrange the labourers who are easily available here. Most of the Afghanis, who have migrated here work as laborer.

The major function or use of the water of this *karez* is irrigation. Other than irrigation people use this water in houses. Some of the water in winter season is stored in a dam, which is made for the wells. Before 1980 there were six water mills, which were operated with the water of the *karez*. Now these water mills are not working because the people do not grow wheat now.

Bowaries (Wells)

From late 1970s onwards, *bowaries* (wells) were the second most important source of irrigation in the village. Now a better technology has been introduced in the village and these *bowaries* are rarely used. The people having smaller share of *karez* water for irrigation started making *bowaries* in their fields to fulfill the water needs. In the mid-1970s *karez* was the only source of

irrigational water in the village. At that time, the people were not so much involved in

³⁴Representative of the lineage who deals with the *karez* related issues.

horticulture/agriculture as they are now. The need for irrigational water gradually increased and *karez* alone couldn't fulfill those needs. So, the people have started making *bowaries*. Haji Payo Khan and Haji Khuda Dad were the pioneers who introduced this technology in this village. In mid 1980s, there were 32 *bowaries* in the village. Among those 32, 27 were operated through tractors and other five were working with diesel engines. Majority of the people having *bowaries* had their own tractors. The people who didn't have tractors got fitted diesel engines with their *bowaries*. The tractors were available on rent at the rate of Rs.300 per day (one day means 8 hours).

Orchards at an area of 95 acres were irrigated with this source. Most of the water was used by the owners to irrigate their own orchards. Some people having surplus water used to sell it to the others after fulfilling their own irrigational needs. In 1987 the rate of water from the well was 80 rupees per hour. This water was not sold on the contract basis. It could be sold to anybody who could pay the money. Some people in the village were giving water free of cost to the others who could arrange for a tractor to pull the water out. In late 1990s, the number of *bowaries* increased up to 83 but the tradition of providing water free of cost almost ended, and the rate of water was 300 rupees per hour. The technology also changed and most of the people started using electric motors in the *bowaries*.

The people constructed *bowaries* in their own land without government help and permission. The government has not imposed any tax on these *bowaries*. If someone starts digging *bowari* close to *karez* or another *bowari*, the government stops it, as there should be a distance of more than 500 yards between them. In such cases the natives complain the Assistant Commissioner or Deputy Commissioner and subsequently the action is taken through levies. There are twelve such *bowaries* on which the work was stopped for being close to the *karez*.

Construction of the *Bowaries*

Before digging wells, the methods of wires and 'Y' – shaped branch, which I have already discussed under *karez*, are used to find out the underground water. After finding water and selecting a suitable place for well, they start digging. The digging methods are also the same, used in digging the tunnels and shafts of the *karez*.

Normally, one gets water 22 – 25 meters deep in the earth. It depends upon weather. In the days when there are fewer rains, the water level goes down and the people have to dig more. Most of the *bowaries* don't have much water, and the people have to make *lamboors* (tunnels) in them to get some more water. Normal length of a *lamboor* is 30 to 35 meters. Some are longer and the longest is 200 meters. To dig long tunnels, they have to make shafts as they do in *karez*. When the people pull that water out with the help of a tractor or an engine, the water finishes after some time in the bottom of the well. Then they have to wait to get more water. For example if the

water gets finished in two hours, they have to wait for one hour or so for its filling. In rainy season the *bowaries* provide more water almost double than the dry season.

When water is found in a well, the owner distributes sweets in the village to express his happiness. And when the work is completed and the well becomes operational, they slaughter a goat and distribute meat among the people, laborers and the neighbors.

The *bowaries* are of different sizes. The diameter of the well could be 9 feet, 12 feet or 18 feet. They have a pump in the bottom, operated with tractors. Some people make small *bowaries* of around one meter width in their houses for water of daily use. They are operated with the help of electric pump. The smaller wells do not have stairs in them. For cleaning people go inside with the help of rope.

MODERN IRRIGATION SYSTEM

In 2002, a major change in irrigation and water supply took place. The government with the help of natives started installing tube wells in the village, which are technologically far ahead than the wells and the *karez*. This improvement has been witnessed in the household water supply also. Now every household has a water connection and is linked with the pipeline.

Tube Wells

These tube wells are operated with electric motors and pumps, which pull water from 450 feet deep in the earth. Before installing these tube wells, 800 to 900 feet deep bore is dug through different machines. A pipe of three inch diameter is installed 450 feet deep in the bore. Sometimes, in the dry season when water goes deeper the people have to increase the length of the pipe without deepening the bore. After putting the pipe in the bore, a powerful electric motor and a pump are installed. A water tank is constructed near the tube well in which water is stored and further supplied to the fields for irrigational purposes. This tank is rectangular in shape sizing 25'x30', with 4 feet depth, uncovered with no roof on the top. From this tank water travels to the fields through pipeline, so there is no wastage of water as it is in *karez* water because it flows through unpaved drains. The tube well water reaches the fields within 5 to 10 minutes whereas *karez* water takes hours to reach the fields particularly those located on the back of the village due to unpaved drains.

The quantity of water provided by these tube wells is much more than the *karez* or the wells. Presently, 70% of the irrigation water requirements are fulfilled by these tube wells whereas 30% by *karez*. The wells are not in use any more for irrigation. The importance of *karez* in their lives has for the first time decreased owing to the advent of new technology.

There are 40 tube wells in the village, 35 of them are privately owned and 5 are owned by the government. The government owned tube wells are used for domestic water supply and the private ones are used for irrigation. Some of the private tube wells are owned by the individuals and some others by the groups comprising kinsmen, depending upon the water requirement and

affordability. The government provides half of the total cost to the natives for purchasing the equipment and installation.

Two NGOs – Jall and Pipeline – are also working on irrigational projects in the village. Jall is working to improve the condition of drains and Pipeline is providing pipelines in the village.

IMPACT OF MODERN IRRIGATION SYSTEM

These tube wells have provided solution to one of the major problems in the village. Undoubtedly it is development but it has brought about some significant changes in the socio-economic structure. Zandrakarez was not only providing the people with water for their irrigational and domestic needs but was also working as a cohesive force among their lineages. It kept the kinship relationship strong for a long time as it has become weaker. Zandra is a well-differentiated society. Their social organization is based on the lineages. The karez water is also shared among the lineage members. In 1980s, the people could not refuse marriage proposals for sharing karez water. Same was the case with the other issues like politics, conflicts or economic transactions etc. however the situation is different today. Now the natives prefer the one who is economically sound and well educated even if he is not a kinsman. Water sharing has no significance for them anymore. So this modern irrigation system has weakened their social integration.

This new water technology has increased per-capita income of the natives. They have started investing on other than orchards. They are improving quality education to their children. Their purchasing power has increased many folds. The shops in the village reported that their sales on Eid Day were almost five times more than that of last two occasions. This increase in per-capita income is leading to a big change in the family structure. The joint families are breaking up into nuclear families. Many people have started their business in Quetta and for the purpose, one or two or even more members of the family have to leave the village while the others are staying in the village to look after the orchards. In some of these cases the family members divided their property separating their respective businesses in the village and the cities because the people living in the village have to put a lot of physical effort to take care of the orchards but the income in the end is distributed equally also to those who did not contributed physically. In most of the cases the people living in the village are not getting anything from the business their brothers are doing in Quetta or elsewhere.

Subsistence economy in the village was gradually moving towards market economy since the advent of apple economy. The modern irrigation system has really enhanced the speed of change. In subsistence economy, people were growing crops for their domestic use and keeping cattle for meeting household needs, meaning thereby that they don't have to spend money to get anything from the market. On the other hand when it opened up into the market economy, the farmer started growing crops to sell in the market and earn money. Now he has to buy almost everything for his personal use from the market. The money which he earns always falls short of his needs because of change in his consumption patron. For example, in the past he drank *lasi*³⁵ to finish

his thirst and served the same to his guests, but today he buys coca cola or any other soft drink

³⁵Milk product; remaining liquid after taking out the butter from the milk

for the purpose. Same is the case with other products which are available in the market and properly backed up with advertising.

Since the middle of 20th century, the village economy was only based on horticulture with apple as the main source of income, but now they are involved indifferent businesses and employment in public and private sector to earn additional income. In order to further supplement domestic income, the women have started working. Some of them have started producing home based handicrafts.

This improved irrigation system was introduced in the village in public-private partnership and some further refinements have been brought with the help of NGOs. This change attracted some more development in the field of horticulture which includes use of technology, modern techniques, transportation, pesticides and chemical fertilizers. Before 1980s, farmers were dependent upon animals for farming and the animal waste for urea. The low profit farm products are no more cultivated. Majority of the natives has replaced cheap quality apple trees with that of expensive ones. They have switching over to the types having great export value, local market demand and high profit. The market is also in transition from local market to the export. Before 1980s, total production was consumed at local markets but now more than 40% of the apple is sold to the exporters.

CONCLUSION

The data presented in the article support the argument of the theorists of the world system analysis. Based on the arguments raised by the paper as supported by literature, the following inferences can be drawn:

1. Shift from subsistence economy to cash economy supports the industry as the raw materials, which includes livestock and farm production are sold in the market to earn money and for personal consumption they are bought from the market produced or processed by the industry. So the ultimate beneficiary of this change remains the industrialist of core countries for being producer of all these products.
2. Moving from horticulture economy to businesses and employments in public and private sector to earn additional income also benefits the industry as it finds cheap labor. Supplementary domestic income by the women folk through handicrafts helps to maintain low wage rates.
3. When joint families break into nuclear families it normally results into urban migration where the majority of the adults work for the industry and their dependence upon the consumer products also increases.

4. Technology, modern techniques, transportation, pesticides and chemical fertilizers used in the village are imported from the core countries sometimes in shape of finished products and sometimes in shape of instillations, industrial supplies and fabricated parts.

5. Use of pesticides and chemical fertilizers gives rise to health problems due to which medical bill increases and the pharmaceutical industry of the core countries gets benefit. The transfer of wealth by exploiting periphery and semi-periphery by core countries which encourages rapid scientific development so that Western medicine and other scientific institutions could surpass underdeveloped countries of the world.
6. Increase in the export of farm products supports Wallerstein argument where he says that world is becoming a single economic unit through exchange and trade with a vast diversity in division of labor among the countries.
7. Intervention of core countries through NGOs and Government sector by providing financial development aid is also visible in the village.

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