

A Novel Approach to Influence of Shallow Wells in Diversification of Sistan and Balouchestan Province Economy: Case Study in Sistan and Balouchestan Province, South–East Iran

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Abstract— Recently, shallow wells are of specific importance in rural economy of Sistan and Balouchestan. Shallow well drilling is one of the populated techniques in this region against drought to diversify agricultural products. Sistan and Balouchestan have very low humidity and rainfall (60 mm per year) compared to other regions of the country due to its geographical position. Regional farmers have numerous problems due to lack of aquifers (except that subsurface flows and agricultural wastewaters) and fluctuation of level of Hirmand. However, they overcame lack of water in recent drought by drilling of shallow wells and utilizing new cropping pattern and even earned income. The current paper expresses the theoretical basics for diversification of Sistan and Balouchestan economic activities and role of shallow wells in some parts such as: aquaculture, greenhouse culture, livestock breeding and so on. Diversification approach and experiences of different countries are firstly considered in theoretical basics as a method to repel drought and finally, a comparison is made about the product variety of farmers and change of regional cropping pattern due to the water of shallow wells. The research method of the current project is a combination of analytical – descriptive and case study – field methods and sampling has been performed by completing questionnaire and interview. According to the findings of the current study, in some regions of Sistan and Balouchestan in which water of shallow depths are available in summer, agricultural products are diversified and income is high and residents are hopeful about the future of their work. However, wheat and barley are planted only, in villages with lower water availability from shallow wells. The economic and social participating of farmers who used from shallow wells is more than other people and shallow wells are performed as safe water resources for economic activities.

Index Terms— Shallow Wells, Diversification of Sistan and Balouchestan Economy, Suitable Cropping Pattern, Province of Sistan and Balouchestan, South–East Iran, Water Resources Engineering, Economic Activities

1 INTRODUCTION

It is believed in international organizations that poverty reduced in national and international scales only when rural poverty reduces [1-8]. In this regard, rural regions have a basic role in national development since sustainable development of each country is directly related to sustainability of rural system of that country. If any pause occurs in the way of progress and development of Sistan and Balouchestan spaces, its effects and consequences affect rural and urban regions and ultimately, whole of the country [9]. As a result, most of development theorists represent and propose diversification approach in the framework of sustainable development [10].

During recent decades, rural development in Sistan and Balouchestan always has high fluctuations. Some the most important factors led to slump in Sistan and Balouchestan development are land separating, lack of attention to diversification of rural economy and continuous droughts. Among these factors, the role of drought is more important than others. Years ago, drought forces people of Sistan region to migrate,

but in recent decade (2005-2015), despite continuous drought, migration is not only slow down, but also the bases for changing the cropping patterns and diversifying the rural economy are provided due to the methods of fighting with this crisis [11, 14, 15, 17]. Shallow well drilling is one of these methods [11-19]. The possibility of shallow wells drilling in Sistan and Balouchestan is more than other regions of Sistan. In this regard, various suitable bases for diversifying the rural economy, cropping patterns, earning income and finally, gratifying the people of the region are obtained [20-25].

Drilling of shallow wells in Sistan and Balouchestan is ignored by academic researchers, while performing an independent research about the role of shallow wells in rural economy of region is necessary. Therefore, the major goal of the current study is investigating about the role of shallow wells in diversifying the rural economic activities in Sistan and Balouchestan.

In this regard, the current research aims to find answer of the following questions:

- 1- If the extracted water from shallow wells lead to diversification in agricultural products of the region?
- 2- If shallow wells are economically rationalized and considering those can be offset side costs?
- 3- If there is a relationship between having shallow wells and hoping to occupational future?

To find the scientific answer of these questions, some hy-

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potheses are represented as follows:

- Use of water extracted from shallow wells has a direct effect on diversity of products.
- There is a meaningful relationship between use of shallow well and annual income of villagers.
- There is a close relationship between use of shallow well and hope to future of occupation.

As yet, any independent research about the diversification of agricultural products and Sistan and Balouchestan economic activities has not been performed, but as a necessity for moving toward this direction, the following issues can be pointed out:

In some research projects, the devastating effects of recent droughts in south-east of country is studied and some suggestions also are represented against the droughts in the region [26-31]. They only proposed the studying of suitable cropping pattern, without any details, to diversify Sistan and Balouchestan economy [32-47]. In another research project, the dispersal of agricultural exploiting in Sistan region - which was studied by sampling - considered and it was mentioned that villagers have low income from agriculture [48-53]. In another study about the diversification of economic activities, some issues studied such as optimum water exploiting, attention to supplementary agricultural activities and so on and further, measures in the way of sustainable Sistan and Balouchestan economy [54-59].

Other researchers studied about the diversification of agricultural products and indicated that it obtains basis for ecological sustainability of agricultural systems [60-65].

2 THEORETICAL BASES

Occurring some global and natural crises such as war, drought, global inflation and also inflexibility of economy of some countries due to relying on one-product economy lead to paying more attention to diversification of economy and, in particular, rural economy in recent years. Countermeasures regarding the effects of drought usually perform in various fields. Here, this issue is followed and studied in two fields: (1) Moving toward the diversification of economic activities of villagers in vulnerable regions and, (2) Regulating the bad effects of drought and searching to find methods for counteracting with those. In the studied region, shallow wells perform these two roles, simultaneously, and here, mutual relations of these two roles are investigated.

Although the issue of diversification of economic activities in developing countries has been discussed (as criticism about growth theories) for a long time, it can be said that it is considered as a new issue in the field of rural development theories. José Dokastro believes that single-planting and unbalancing of regional production lead to starvation and hunger; and he states that its solution is type of planting and variety of economical activities [66-69]. Paul Baran, criticized the economical situation of single-product countries, and recommended to Socialist countries to follow an economy with diversified economic activities so that predispose the salvation of developing countries [70]. As dangers reduced by diversifying the economic activities and agricultural products, output of the social

system will be distributed, more fairly, to vital parts of the system [71, 72]. Experts of World Bank believe that the relationships between urban and rural regions can improve job opportunities out of agriculture sector and propose a media to diversification of rural activities [73-81].

Agricultural cooperatives also can improve the level of cooperation in the society and farmers who are members of such organizations, can gain more profit due to cooperation with others and because of possibility of cheaper purchasing of inputs and more suitable selling of their products. Consequently, with higher net income, a more sustainable cropping activity, from economical point of view, will be formed and it, in turn, causes to more flourishing of regional trades [82-85].

Cooperation and common activities are diversifying tools and cause to constancy and stability of the society [78, 85]. Economic variety is of more importance in regions relying on single cropping and attending to Sistan and Balouchestan industries and engaging to non-agricultural activities predispose to creating diversification in Sistan and Balouchestan economy [75-85]. Creating non-agricultural jobs will be blocked the migration of villagers, in addition to supporting columns of rural economy [83]. Providing a system to perform various economic activities not only causes to reduce the problems of cities [84], but also equalizes the quality of rural and urban lives [85], and finally, it will facilitate the process of Sistan and Balouchestan development.

Having cooperation of vulnerable villagers increase their self-assurance, in addition to economic development accompanying by social justice and utilizing domestic knowledge [80]. One of the most important factors which can be very effective in creating income variety in rural regions is rural entrepreneurship through attracting business from other regions, especially urban ones, to villages [81]; but about the managing of natural hazards with emphasis on drought, it should be said that drought is a problem which has been previously considered by various researchers but its scientific study is started in twenty century, since climatology started to progress.

Representing methods for climate categorization by some researchers and others can be counted as a milestone of these investigations. Palmer [82], an American researcher, is one of the primary researchers which investigate, scientifically, the various characteristics of this phenomenon, in United States, by statistical methods [83]. One of the goals of rural welfare services program in poor rural regions of United States is rehabilitating the rural societies to make some plan for encountering extraordinary events such as drought, flood and other natural events and to have necessary preparation against these events [84].

In interior Mongolia, China, organic substances of surficial soil are eroded due to extension of desertification and effect of wind on steppes and pastures and as a result, agricultural lands are changed to wastelands [85]. Therefore, Chinese government encourages farmers to protect soil in regions which are subjected to severe wind erosion and recommends to plant specific types of products which reduce soil erosion [82-85]. Drought has been a continuous phenomenon in most parts of India so that 19% of Indian area and 12% of the population of this country are subjected to drought, especially in Rajasthan,

where drought is returned every few years. The losses are minimized as a result of constructing water tank with cooperation of local society, suitable cropping pattern in arid and semi-arid regions and optimum use of water and soil, accompanying by suitable relationship and balance between associated organizations [77-83], and it is possible to use this plan in larger regions as a successful method. Iran is among the first ten eventful countries around the world and every year, natural hazards impart huge losses to the economy of the country so that the vulnerability and risky position of the country is an obstacle on the way toward the development of the country [78, 82]. Drought is considered by beneficiary and responsible people, in addition to researchers. In this regard, various methods are proposed against drought in the studied area which drilling of shallow wells is one of those. While this issue is an effective factor against adverse effects of drought, it predisposes diversification of economic activities.

3 RESEARCH METHOD

In the current research, 84 villages with 1136 families were selected among 327 villages of Sistan and Balouchestan, based on Cuchran formula, at first [79-85]. Then, villages were divided into three population groups of 0-40 families, 41-80 families and higher than 80 families, and the volume sample of number of families were determined relative to population of village. The main tool for collecting information in this research was the questionnaire prepared by the researcher. The questions are determined and adjusted so that it can be possible to investigate various aspects of economical life of villagers such as economical aspect (amount and variety of income sources, availability of credits, area of agricultural land, availability of market, distance from urban centers, and migration from village), and natural and ecological aspect (availability and productivity of water, optimum productivity of soil, observance of periodic cropping, and availability and use of fertilizers and poisons). In addition, it was tried to widen the research to villages with high, low and middle population.

Regarding the sampling method in the first step, 84 villages were considered as the volume sample based on Chocran formula. According to direct effects of population of villages on obtaining diversification bases of agricultural products and related activities, villages were divided into low, middle and high population and the volume sample was chosen as 1136 families proportionate to population and number of rural families. To evaluate cost of shallow wells and earned income from this plan, agricultural exploiters are directly voted.

Method and tool of data and information collecting was use of documented and library studies. A direct field study is performed through face to face completing of questionnaires and interview with associated experts and professionals and local skillful people. In fact, the research method in this study is descriptive - analytical.

4 DEFINITION OF CONCEPTS

In the current research, use of shallow well is considered as independent variable; variety of product, annual income and hope to future of occupation are dependent variables and their

scale is serial scale.

The purpose of use of shallow well is availability of the amount water, extracted from shallow wells drilled in drought season, which is replaced to the water of Hirmand, and obtains a safe water resource for economical activities. The purpose of variety of product is the number and composition of products induced by agricultural and non-agricultural activities of rural families which it is operated in the current study based on the annual number of agricultural and non-agricultural product. The amount of annual income is the sum of annual income of Sistan and Balouchestan families through agricultural, breeding, horticultural and handicraft activities and their other income resources in terms of Rials. The amount of hope to future of occupation is measured as the amount of satisfaction from current situation of agriculture through availability of agricultural inputs, insurance, credits and output of shallow wells.

5 RESULTS AND DISCUSSION

As previously mentioned, due to severity of continental conditions and other intensifying factors in the region, villagers tend to a method for continuing their life and this method is drilling the shallow wells which the role of this technique in diversifying the economical activities is investigated. The following reasons can be counted for drilling shallow wells: severe periodic fluctuation of Hirmand, improper seasonal distribution of its water, land development of Hirmand valley, construction of storing dams in Afghanistan and occurring of drought in the region and so on. Flow rate of shallow wells are low due to lack of groundwater and low volume of water in surficial reservoirs.

By studying monthly, seasonal and annual distribution of water flow of Sistan River during the 44 years mentioned period, it is indicated that the regime of river depends on snow melting, and water inflow to the river is seasonally and monthly. Water flow is lowest in fall, while the demand of agricultural lands for water is at maximum level. Water flow in summer is approximately same as to fall and lack of water causes to water is available in lesser parts of the city. As a result, the number of farmers intended to crop patch plants reduced and hence, variety of products in regions with more limited access to water is decreased. More than 59% (about 60%) of water flows during spring and remained water flows during other 9 months of year. At the beginning of spring, water flow increases as warming the air and melting the snows and its maximum level is reached in May.

There was a severe fluctuation in under cropping areas of Sistan region during 1973-1987. In 1973, 47 thousands of hectares were cropped in the region while this was reached to 115 thousands of hectares in 1986 and then, in 1987, it was again reduced to 53 thousands of hectares, which is approximately equal to the under cropped area in 1973 and then, it was again increases in the next years. The severe fluctuation of number of livestock during two decades (1960-1980) also is directly related to volume of water inflow to Hirmand.

The average under cropping area for each shallow well is between 0.8 and 1.5 hectares in the region which it may be due

to different water output of similar shallow wells. Typically, the diameters of shallow wells are 2-3 m and their depths are 6-12 m. The deepest drilled well in the region is of 54 m depth with 4 in. continuous water output, covers approximately 10 thousands of hectares and the electric conduction of its water is between 1.92-2.

The purpose of Sistan and Balouchestan economy is all activities performed in Sistan and Balouchestan environment and exploited by villagers. In the other words, Sistan and Balouchestan economy includes all activities - whether agricultural or non-agricultural - performed in Sistan and Balouchestan environment to supply demands of villagers.

Due to lack of water in the region, use of submerged irrigation for cropping wheat and barley was not easily possible. Hence, farmers was sought to find products which makes profit with small amount of water. After drilling shallow wells, therefore, the under cropped area of wheat, barley, alfalfa, and oily grains are decrease from 63 to 56%, 20.4 to 14.01%, 3.9 to 3.8%, and 0.08 to 0.007%, respectively; however, other products such as feed millet, onion and green house products are constantly cropped for the first time in the region and production of leaf green, patch products and sapphirine grape are increased from 0.01 to 0.1%, 7.7 to 18% and 0.2 to 2.4%, respectively.

By removing aquatics of Hirmand and Hamoon, which family economy of more than 3500 fisherman is related to them, shallow wells and water storage pools can be used in two periods of year for warm and cool water aquaculture. In addition to agricultural and breeding activities, aquaculture also is a type of supplementary income. Aquaculture, especially warm water type, as stated by exploiters, does not need to high cost and work; but at the end of season, 300-400 kg fish can be exploited from a 200 square meter pool (10×20 m) and exploiters earn 1350000-1450000 Tomans as the price of 1 kg fish is about 4500 Tomans. 2.35% of respondent acclaim their source of income to Fishery Organization. Certainly, aquaculture causes to enriching of pool's water, improving of soil's quality, and enhancing of microorganism activities in soil, stabilizing nitrogen in soil, and finally increasing of agricultural products, in addition to economical advantages. As the water of shallow wells has a little amount of dissolved oxygen, pools are usually constructed about 50-100 m far from the shallow wells to allow oxygen to dissolve in the water, before it enters to the pool.

One of the countermeasures against drought which is considered since 1999 is creating green house. Warm welcome of farmers, especially Sistan and Balouchestan young people and graduates of agriculture section, regarding the engendered occasion to water extracting from shallow wells led to developing of this plan in the region.

The reasons for accepting green houses in agricultural activities can be listed as: possibility of utilizing and earning sufficient income from small lands, creating continuous jobs, economizing productive inputs, implementing graduated people and new sciences, and reducing the risk of production related to continent.

5.2% of total sample families are acclaimed that their income source is horticulture, especially sapphirine grape. Due

to unripe nature of this product and quality of product and its high price, it is a very good income source for horticulture families. The average sapphirine grape cropped per hectare is 5-8 ton; considering an average price of 1500 Tomans per kg, the economical advantage of this product can be confirmed. In 2010, more than 350 hectares are under cropping of sapphirine grape in Sistan and Balouchestan and it is still developing. Meanwhile, loan to vine is provided only if the irrigation system is under pressure. It should be noted that this issue has some practical deficiencies. In under pressure irrigation, weeds can be easily controlled and there is not surficial water flow due to low pressure and flow rate and as water is continuously available to plant, it has a suitable quality and quantity.

Cropping under plastic covers and making the product, out of season, unripe allow moving toward economical cropping. Growing plants such as potato, garlic, onion, eggplant and summer crops are considered in this type of agriculture which is the start of moving toward economical agriculture. According to sampling from selected villages, 0.2% of respondents are cropped out of season products.

Units of industrial aviculture with capacity of 20 thousands chickens are developing using water of shallow wells. Private sector is very interested in this activity and it is of high rate of entrepreneurship. 75.3% of respondents acclaim that their income source is breeding. Apiculture is a supplementary economical activity in addition to agriculture and breeding. The average of production is 13 kg per apiary and its sell price is as high as 60000 Rials, which makes apiculture an auxiliary economic activity.

The presence of shallow wells and aquaculture pools can be useful in parts other than agriculture - for example - it can juice-up the service and tourism sections. Meanwhile, tourism development provides a part of credits needed for improving services and facilities for local societies and infrastructures will be reinforced and migration of villagers also will be reduced as a result of Sistan and Balouchestan development.

6 CONCLUSION

Based on the findings of this research, it was indicated that drilling of shallow well in drought condition of Sistan and Balouchestan is a factor reducing the risk of water resources and it can be considered as a safe water supplier. Drilling of shallow well makes a suitable media for cropping various types of agricultural products and allows diversifying the Sistan and Balouchestan economic activities and changing the suitable cropping pattern, which finally leads to satisfaction and remaining of residents of region when lack of water induced crises are emerged.

The under cropping area of shallow wells is about 3675 hectares, regarding 2450 shallow wells (2450×1.5=3675 hectares). Although use of shallow wells allows changing of cropping pattern and reduced the amount of some low income products and promoted some new products in the region, it seems that the number of shallow wells should be increased regarding the area under cropping of some products such as alfalfa in gardens and green houses which are needed continuously to

water. Comparing the area under cropping with shallow wells and the total under cropping area of Sistan and Balouchestan. It is due to poverty, natural factors and attracting some people to non-productive jobs.

Because of lack of stabilized water and regarding to water stresses and other continental factors, most of farmers believe that their job is risky and they ignore financial facilities provided by banks since they are not able to pass their payments (73.9%). Anyway, limitations of laws and regulations of banks in loaning and various deficiencies of credit system also intensify this process. Moreover, villagers are not interested in insurance of agricultural products due to continuous loss of these products and hence, widespread poverty, which induced by lack of stabilizing the water and number of shallow wells.

Increasing the performance of wheat among the families who use from shallow wells, with average of 1.7 ton per hectare comparing to lower than 1 ton per hectare, for who their agricultural activities are depend on variable water of Hirm-and, show the effect of shallow wells in enhancing the performance of agricultural products. Using the water of shallow wells, changing the cropping pattern from costly and low income products such as: wheat and barley to cheap and high income ones such as vegetable and summer crops is under programming. Storing the water of shallow wells, also, allows aquaculture. Constructing the pools increases the efficiency of irrigation since as water stored in pool for 12 hours, the flow rate will be doubled in the next 12 hours and water progressing in land will be increased at least three times.

Use of under pressure irrigation, agricultural insurances and loans, and conferring to agriculture promoter, governmental offices and banks among who have use from shallow wells are higher than others. While 46.3% of villagers have not any access to agriculture promoter, 73.9% of villagers do not use from agricultural loans due to poverty and 73.4% of farmers are not interested in agricultural and breeding insurance. It should be pointed out that the water output and quality of water extracted from shallow wells located in this region is more appropriate than other ones.

According to the performed studies, there are still challenges and problems in the region, in spite of drilling the shallow wells. Social and economical challenges and water stresses in the region are examples of these problems. Regarding the social challenges, fast growing of population and hence, increasing the young people, migration of villagers, lack of promoting an efficient and intent agriculture and also high occupational sponsorship factor, illiteracy and so on can be mentioned. Agricultural land separating and hence, shrinking, low earned income, lack of easy access to bank credits, high demand for job and inattention to handicrafts are a number of economical challenges in the region. Lack of providing and stabilizing agricultural water, improper process of water conveyance to agricultural lands and lack of integrity in water management can be counted as water stresses in the region.

Although the existence of groundwater resources in Sistan plain has been rejected by hydrological studies as yet, it is necessary to perform a new detailed study in the regions with watery shallow wells, and if the existence of these resources is confirmed, summer crops and gardens should be much more

considered.

For agricultural utilizations, it is recommended that conveying the water of shallow wells resources to neighboring villages and applicant of under pressure irrigation system and new cropping methods, such as greenhouse culture and efficient economical crops, is considered, initially, in a pilot project and in small scale; and if the results is positive, it is necessary to cover more regions in the next steps so that safer accessibility to agricultural water is provided for farmers. Regarding the continental limitations and water stresses of the region, more attention should be paid to industry and services section in addition to diversifying the agricultural products.

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