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# PATH ANALYSIS OF DAM IMPACT IN VIEWPOINT OF IRANIAN FARMERS

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**ABSTRACT:** Without water, life on Earth is meaningless; then, this century would be named the century of struggle for water ownership. Nowadays, water is the basic subject of development in different countries in the world. Therefore in the current situation, water is considered as basic issue in commercial development and social welfare. In all countries, dams have been made with different aims, such as, water supply, power generation, irrigation, flood reduction and etc. dams have been made about 60% of the world's great rivers and this subject had affected on the regional environment development. This study, was assessed the path analysis of dam impact in viewpoint of Iranian farmers. The beneficiaries of dam irrigation network in Hanna dam were 1,610 households that by using the Cochran formula, 210 samples were obtained and the necessary data was collected by using from questionnaires and interviews. The validity of the questionnaires confirm from experts viewpoint and its reliability of the questionnaires calculated by using the Cronbach alpha coefficient assigned to the different parts of the questionnaires respectively: economical dimension 84%, social dimension 71% and ecological dimension 75%. The result of path analysis showed that economic and production development of independent variables respectively with the standardized coefficients 0.394 and 0.477, have the greatest effect on the sustainable development in farmer's viewpoint.
**Keywords:** Path analysis, economical impact, Social impact, Environmental impact.

## INTRODUCTION

Due to rapid population growth and increasing water needs, including drinking, industry and agriculture, needs for robust management due to optimist use of water resources is undeniable. Nowadays, water is the basic subject of development in different countries in the world. Therefore in the current situation, water is considered as basic issue in commercial development and social welfare. In all countries, dams have been made with different aims, such as, water supply, power generation, irrigation, flood reduction and etc. dams have been made about 60% of the world's great rivers and this subject had affected on the regional environment development. Further, in the presence of climate change, dams may play an increasingly important role in protecting water resources. For example, areas affected by severe drought and those subject to high vulnerability from flooding due to heavy precipitation will likely increase in coming decades [3,4]. Dam construction and water development projects create wide-ranging social, economical and environmental consequences with impacts extending well beyond the initial planning area. The various impacts caused by dams and reservoirs can be on different levels: local, regional, national or international. In the few instances where dams have been found to have an effect on regional employment growth, the effect is more likely to be connected with recreational uses of the resultant reservoir rather than effects on transportation, utility, or water costs that might potentially lure water using industries to the region. The environmental consequences of large dams are numerous and varied, and includes direct impacts to the biological, chemical and physical properties of rivers and riparian (or "stream-side") environments. Dam construction and water development projects create wide-ranging social, economical and environmental consequences with impacts extending well beyond the initial planning area.

Dams have contributed to human development by providing. Beyond the physical and ecological impacts associated with hydropower projects, such debates also focus on the geographical distribution of electrical power and water resources, the administrative decision-making process, the inclusion of relevant stakeholders, the relocation and resettlement of displaced inhabitants, and the disruption of social, cultural, and economic life in communities affected by dam construction [13].

## Review of literature

Saleh and Mondal (2001) evaluated the impact of Bakkhali and Idgaon rubber dam projects in Bangladesh. They examined hydraulic, agricultural and socio-economic factors of the dam in the area through field surveys. They found improved socio-economic indicators of the project and termed the project a viable project. The crop yield and water productivity had improved in both projects however new area irrigated was very less as compare to the actual targets. The actual water availability was much less than the targets as the same were overestimated in both projects during feasibility study stage [10]. Pender and Berhanu (2002) investigated the impact of small irrigation schemes in Tigray in Northern Ethiopia. They observed significant improvement on agriculture sector due to these projects. They observed considerable increase in the use of agriculture inputs such as oxen, labor, fertilizer, improved seeds. The crop production had significantly improved. They found that crop production was 18% higher than in rainfed areas [9]. Benin and et al (2002) also found similar results in a study in Amhara Region in Ethiopia. They observed increased use of agricultural inputs such as fertilizer, chemicals, improved seeds, pesticides, labor after development of small scale irrigation schemes [12]. Maingi and Marsh (2002) studied the dam construction along the Tana River, Kenya and research result showed that, this project impacted on the riverine forest and flood recession agricultural activities in the lower flood plain [7]. Wajid and et al (2013) in a study entitled socio economic impact of small dams on local vicinity have come that after construction of dam in the study area, the crop revenue has significantly increased. The traditional cropping pattern has been shifted to the market oriented crops while yield of almost every crop has been improved. The number of livestock has also been increased. The water table has improved and wells were recharged as before dam construction, people were facing acute shortages of water for domestic use [12]. Owusu and et al (2011) in studied the impact of irrigation on the social welfare in the rural Savannah region of Ghana. Using propensity score matching (PSM) and switching regression techniques it was found that irrigation water availability had positively affected the socio-economic conditions of the people. The net farm income after irrigation water has shown significant increase. They strongly recommended construction of irrigation systems for poverty reduction in both regional and national level [8]. Ashraf and et al (2004) studied the impacts of Khasala, Jawa and Dhok Sanday Mar dams in Punjab. They found that after construction of these dams, the income, land use, crop intensities and crop yield of the farmers have been considerably increased. The cropping pattern has been shifted towards high valued market oriented crops. The water table has improved. The irrigation methods used were still conventional. They suggested that an integrated program should be developed and implemented in the command area of these dams for the effective utilization of available water and development of irrigation infrastructure. They contended that even more area can be irrigated with the same available water and infrastructure if it is managed properly [1]. The results of study (Khalili and Zamani, 2009) showed that the farmers' attitudes toward participatory in irrigation management were dependent to: family size, the problem perception, dependence on the dam for water, and educational background have influenced their participatory in irrigation management. Moreover, based on farmers' perspectives, unequal water distribution among farms, dissatisfaction with water authority operators and high water fees and charges were the main problems and obstacles toward farmer Participatory in irrigation management [5].

Cheema and Bandaragoda (2007) studied the impact of Mirwal & Shahpur small dams in Punjab, Pakistan. They found that in both dams there was no effective warabandi among the farmers. The existing warabandi was not followed by the farmers. The water conveyance network for both the dam was not properly maintained due to paucity of funds and manpower. The beds of canal were ruined and bushes were grown in cracks which impede water flow. It was observed that most of the areas under the command of these small dams were not leveled. The farmers were facing non availability of other agriculture inputs such as fertilizer, pesticide, good quality seed etc. At the end they suggested that Government should introduce an effective and justified warabandi system in the area, provide sufficient funds for operation and maintenance of the canal and provide other agriculture inputs at right time and low prices [2]. Munawar, Zakir and Muhammad (2004) studied the impact small scale irrigation on the agriculture productivity and poverty level of the farmers in the marginal areas of Punjab, Pakistan. They found that poverty level is high in rainfed areas as compared to irrigated areas. The poverty head counts were 26% in irrigated and irrigated plus rain-fed areas while it was 37 % in the rainfed areas. The major portion of annual income of poor was from agriculture while for non-poor it was business. Similarly major portion of poor expenditure was on food. The agriculture productivity and profitability of the poor farmers is low as compare to the non-poor farmers, while the cost of production is higher of poor farmers as compare to nonpoor farmers. They found strong link in the increase of crop production due to small scale irrigation schemes, which will ultimately decrease poverty in the study area [12].

## RESEARCH SETTING AND METHODOLOGY

### Research areas

Isfahan province, with an area of about 107,045 square kilometers, equivalent to 6.3% of the total area of Iran is located between 30 degrees 43 minutes and 34 degrees 27 minutes north latitude and 49 degrees 38 minutes and 55 degrees 32 minutes east of the Greenwich meridian.

The province is 1550 meters above the sea level altitude and is situated in the center of Iran. The province consists of 52 hydrological units belonging to 9 basins and 27 sub-basins. Rivers are small and temporary, with the exception of the Zāyandarud, which totals 405 km in length, with an average slope of 0.3 percent, average annual discharge of 1,053 mcm, average annual precipitation of 450 mm, and a basin area of 27,100 $km^2$. Semirom County is a county in Isfahan Province in Iran. The county is subdivided into two districts: the Central District and Padena District. The county has four cities: Semirom, Komeh, Vanak, and Hanna. Hanna Dam is located at the longitude of 51.7661765 and latitude of 31.2076116.

### Methodology

This study was Analysis the impact of construction the Henna dam in Iran use of the path-analysis and stepwise regression methods, from the attitudes of resident of Hana County. The beneficiaries of dam irrigation network were 1610 households that by using the Cochran formula, 200 samples were obtained and the necessary data was collected by using from questionnaires and interviews. Reliability of the questionnaire was determined by Chronbach alpha test. Alpha value is in range 0 to 1 so that internal reliability of items is found through this coefficient. If this coefficient is zero, it will show full unreliability of items and if it is one, it will show full reliability. If alpha value is more than 0.7, questions and items are suitable for testing the concept or the related variable. According to table 1 it is found that questions and items of the questionnaire is higher than 0.7. For this reason, it is scientifically valid to describe and test relations of variables.

**Table 1. Reliability analysis (Alpha).**

| Scale Name | No. of items in the scale | Alpha value |
|---|---|---|
| Economic factor | 28 | 0.846 |
| Social factor | 17 | 0.752 |
| Ecological factor | 17 | 0.712 |

Descriptive statistical methods were used to this research such as: means, standard deviations, and also the step by step multiple regression analysis and Path Analysis were used in this research.

Path analysis (PA) is a statistical technique used primarily to examine the comparative strength of direct and indirect relationship among variables. PA was introduced in to social scientific research by Blalock, Duncan and others. Sociologists Peter Blau and Otis Dudley Duncan were among the first to utilize path analysis extensively in their research processes involved in status attainment [6]. Also PA is an extension of multiple regressions. It goes beyond regression in that it allows for the analysis of more complicated models. In particular, it can examine situations in which there are several final dependent variables and those in which there are "chains" of influence. Path analysis is extremely powerful for examining complex models and for comparing different models to determine which one best fits the data [11]. PA is easier to understand, in PA rely very heavily on pictures called path diagrams to visualize what's going on. In PA, we don't talk about "independent" and "dependent" variables. Instead, we talk about exogenous variables and endogenous variables. Endogenous variables are variables that are caused by one or more variables within the model. Path model often report the standardized regression coefficients (beta) or estimated path coefficients that have been converted in to standardized z-score, for each casual path depicted in the model. Standardized coefficients allow researchers to compare the relative magnitude of the effects of different explanatory variables in the path model by adjusting the standard deviations such that all the variables, despite different units of measurement, have equal standard deviations. Since the path analytics method follows the usual assumption of ordinary least squares regression, all the relationships depicted in Fig.1 are assumed to be linear, additive, and casual. Therefore, the model can be specified by a series of path or structural equations that describe the direct casual relationship between the variables [6].

## RESULTS

The gender distribution of respondents was 33.5% female, 66.5% male. The highest proportion of the respondents (36%) fell into the 31–45 year age group. The results of research showed that the educational level of farmers was 16.6% illiterate and have not had formal training and 22% of the respondents have elementary education level. Also, 10.2% of the respondents have a higher education level. The results of research showed that most respondents have 2-5 Hectare land. The results of research showed that 65% of the respondents can use dam water for agricultural irrigation. Table 2 shows the demographics of the respondents.

**Table 2: Profile of respondents (n=200)**

| Variables | | Frequency (s) | Percentage of total (%) |
|---|---|---|---|
| **Gender** | Male | 133 | 66.5% |
| | Female | 67 | 33.5% |
| **Age** | 15–30 | 69 | 34.5% |
| | 31–45 | 72 | 36% |
| | 46–60 | 45 | 22.5% |
| | 60 and over | 14 | 7% |
| **Education** | No school education | 33 | 16.6% |
| | Elementary school | 44 | 22% |
| | Junior high school | 72 | 36% |
| | High school | 31 | 15.2% |
| | Junior college | 9 | 4.7% |
| | Bachelor's degree and over | 11 | 5.5% |
| **The amount of dry and irrigated land** | Landless | 2 | 1% |
| | Under 2 Hectare | 39 | 19.5% |
| | 2-5 Hectare | 62 | 31% |
| | 6-10 Hectare | 48 | 24% |
| | 10 Hectare and over | 49 | 24.5% |
| **Agricultural water source** | Well water | 17 | 8.5% |
| | Water Fountain | 30 | 15% |
| | Subterranean water | 22 | 11% |
| | Dam water | 131 | 65.5% |

Step by step multiple regression analysis was used to analyze the affective factors in favorable development (economical, Infrastructure, welfare, social, investment, product, Participatory and personal development). According to the results, in first step, the role of affective factors in the favorable development with 0.241 coefficient of determination was taken into analysis. At the second steps the variable of affective factors in the favorable development was analyzed. This variable specified 34.4% of the changes related to the dependent variable. At the three steps, these factors specified 50% of the changes related to the dependent variable. At the fourth steps, these factors specified 51.6% of the changes related to the dependent variable. Analyses of these total variables showed that they specify about 52.8% of the changes related to conformity of the favorable development. Analyzing β of the changes showed that the role of affective factors is the most influential variable. Other results are shown in Tables (3) and (4).

**Table 3- Step by step regression analysis 2**

| Steps | R | $R^2$ | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | 0.491 | 0.241 | 0.238 | 3.948 |
| 2 | 0.587 | 0.344 | 0.338 | 3.679 |
| 3 | 0.707 | 0.500 | 0.492 | 3.221 |
| 4 | 0.718 | 0.516 | .0507 | 3.176 |
| 5 | 0.727 | 0.528 | 0.517 | 3.143 |

According to the regression coefficient the regression line equation could be written as:

$$Y= 11.48 + 0.152\ x_1 + 0.162\ x_2 + 0.114\ x_3 – 0.054\ x_4 – 0.036\ x_5$$

**Table 4- influential factors on conformity of the affective factors in favorable development**

| Variables | B | Beta | Std. Error Beta | T | Sig. |
|---|---|---|---|---|---|
| **Constant** | 11.48 | -- | 3.379 | 3.398 | 0.001 |
| Economic Development | 0.152 | 0.405 | 0.019 | 7.911 | $0.000^{**}$ |
| Product Development | 0.162 | 0.431 | 0.02 | 8.169 | $0.000^{**}$ |
| Participatory Development | 0.114 | 0.364 | 0.018 | 6.334 | $0.000^{**}$ |
| Investment Development | -0.054 | -0.12 | 0.024 | -2.269 | $0.024^{*}$ |
| Infrastructure Development | -0.036 | -0.108 | 0.018 | -1.956 | $0.05^{*}$ |

** significance in 0.99 level (P≤ 0.01) * significance in 0.95 level (P≤ 0.05)

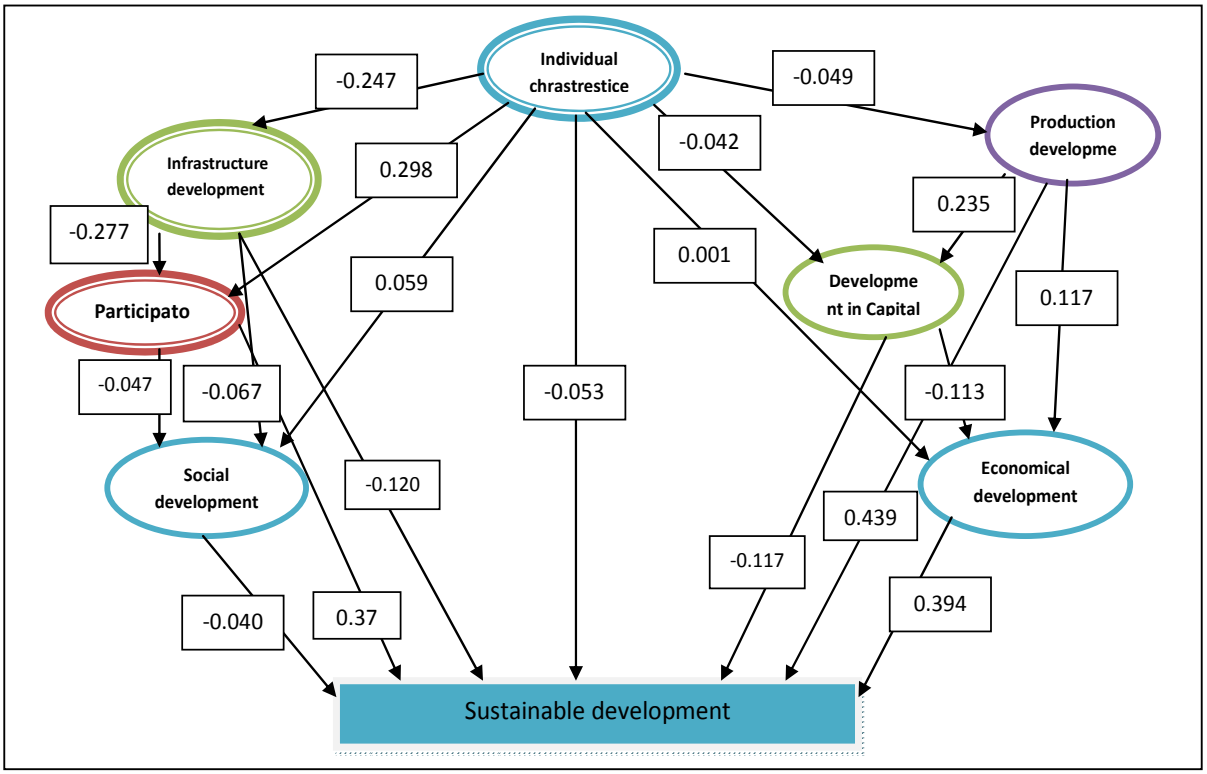
In this study, either for direct and indirect effects of variables on the dependent variable (favorable development) based on the schematic design than standard insurance coefficients calculated using SPSS app was acting. Summary of results of direct and indirect effects of independent variables for the study are presented in Table 5.

**Table 5- Direct and indirect effects of different variables on the favorable development**

| Independent variable | direct effects | indirect effects | Total direct and indirect effects |
|---|---|---|---|
| Personal Development | -0.053 | -0.108 | -0.161 |
| Economic Development | 0.394 | --- | 0.394 |
| Product Development | 0.439 | 0.027 | 0.453 |
| Investment Development | -0.117 | -0.05 | -0.17 |
| Social Development | -0.04 | --- | -0.04 |
| Participatory Development | 0.37 | 0.001 | 0.371 |
| Infrastructure Development | -0.12 | -0.64 | -0.77 |

Based on table 5 results and information obtained with considering the standardized coefficients and taking the path equations we can investigate the path model showed the form below diagram. Depicted in the diagram, directly or indirectly, the effect of each variable on the corresponding vectors have been identified. So that it can be seen economic and production development of independent variables respectively with the standardized coefficients 0.394 and 0.477, have the greatest effect on the favorite development. Also, social and infrastructure development variables respectively with the standardized coefficients -0.04 and -0.76, have minimal effect on the favorite development variables.

The mathematics of the research model based on path equations is obtained, as follows:




## DISCUSSION AND CONCLUSIONS

The result of research showed that 16.6% Iranian farmer's education level in research area was illiterate. It seems that the lower the education level of farmers is one of the fundamental problems to achieve in sustainable agricultural development. Also the results of research showed that most farmers in research areas have average 2-5 Hectare land. Acreage was very small thus cannot create production, income and suitable investment in order to achieve sustainable development. The results of research showed that 65% of the respondents used dam water for agricultural irrigation.

Therefore farmer's reliance to supply dam water for agricultural irrigation was very high. the results of regression analysis showed that in the viewpoint of farmers the maximum impact of dams was involved to: economic dimension, enhanced the agricultural production an develop the farmers participatory in the region. In this study, to investigate the effects of direct and indirect exogenous variables on the mediator and dependent variables were used path analysis method. In general, enhanced the agricultural production with the standard coefficients 0.477 in the viewpoint of farmers was the greatest impact of Hanna dam in this area. Also in the viewpoint of farmers the Hanna dam has the positive impact to economical and participatory development in this area. But the impact of Hanna dam to personal, social, investment and infrastructure dimension was negative in this area.

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## REFERENCES

[1] Ashraf, M., Kahlown, M.A., Ashfaq, A. 2004. Impact evaluation of water resources development in the command areas of small dam. Pakistan Journal of Water Resources, 8(1), pp.23.

[2] Cheema, M. & Bandaragoda, J. 1997. Social organization for improved system management and sustainable irrigated agriculture in small dams: baseline survey for farmers organizations of mirwal and shahpur small dams, Punjab Pakistan, Research Report 338, Lahore: International Water Management Institute.

[3] Government of Khyber Pakhtunkhwa. 2004. PC-I for construction of small dam at Aza Khel Mattani District Peshawar. Irrigation Department, Peshawar.

[4] Inter governmental Panel on Climate Change, 2007. Working Group 2: Impacts, Adaptation, and Vulnerability. http://www.gtp89.dial.pipex.com/chpt.htm

[5] Khalkheili, T.A., Zamani, G.H., 2009. Farmer participation in irrigation management: the case of Doroodzan Dam Irrigation Network, Iran. Agricultural Water Management. 96, pp.859–865.

[6] Llears C (2005). Path analysis. Enculopedia Social measurement, 3, pp.25-30.

[7] Maingi, J.K & Marsh, S. E. 2002. Quantifying hydrologic impacts following dam construction along the Tana River, Kenya. Journal of Arid Environments. 50, pp. 53-79.

[8] Owusu, E. S., Namara, R. E., Kuwornu, J. K. M. 2011. The welfare-enhancing role of irrigation in farm households in northern Ghana. Journal of International Diversity, 1, pp.61-87.

[9] Pender, J., Berhanu, G. 2002. Impacts of policies and technologies in dry land agriculture: Evidence from northern Ethiopia. Paper presented at the symposium on challenges and strategies of dry land agriculture into the new millennium. Annual meeting of the American Society of Agronomy, the Crop Science Society of America, and the Soil Science Society of America, 13 November 2002, Indianapolis, USA.

[10] Saleh, A. F. M. and Mondal, M. S. 2001. Performance evaluation of rubber dam projects of Bangladesh in irrigation development. Irrigation and Drainage, 50, pp. 237–248 .

[11] Streiner L D 2005. Finding Our Way: An Introduction to Path Analysis. The Canadian Journal of Psychiatry—Research Methods in Psychiatry. 50, (2). pp.115-125.

[12] Wajid, A & Usman, A & Kashif Khan, M. 2013. Socio Economic Impact of Small Dams on Local Vicinity: A Case Study of Aza Khel Dam Peshawar. Global Journal of Management and Business Research Economics and Commerce.13 (5), pp. 30-39.

[13] World Commission on Dams, 2000. Dams and Development: a New Framework for Decision-Making. Earth scan, London.