**Public Works Research Institute (PWRI)**

**National Graduate Institute for Policy Studies (GRIPS)**

**RESEARCH PROPOSAL 2019-2020**

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| **For GRIPS use: Application ID** |  |

(Please write 2-4 pages in total; you can change the size of the boxes.)

**Background** (1-2 paragraphs, maximum 400 words)

Please describe a policy issue or issues you would like to address and their significance. Your description should include not only a description of your country, organization, or recent events but also an analysis of the problem you plan to address and its importance. Your description should make clear the purpose of your study at GRIPS.

**Title: Investigating the effects of climate change and the development of drainage basin infrastructures on precipitation and flow coefficients in non-stationary conditions, in order to elaborate input data into a dynamic system of flood risk management**

Among natural disasters, flood, earthquakes and drought are of special importance in terms of financial and life damages caused due to them. According to the statistics, flood damage has the highest rate of damage among the natural disasters in the world. Hence, flood is one of the main causes of damage in terms of mortality and financial damages and the destruction of civil infrastructure. The frequency and consequences of severe flood events have increased rapidly throughout the world in recent decades. The main factor of this increase is the growth of the world's population, and consequently the increased economic and social activities in flood-prone areas and climate changes occurring in most countries of the world. Deforestation, urbanization and reduction of wetlands with decreasing water accumulation in the drainage basin and increasing runoff production on the one hand and climate changes with major changes in temperature and rainfall pattern on the other have increased the probability of severe rainfall or drought in different points of the earth. The concentration of human economic activities in the floodplains will increase the importance of examining the flood control strategies. In most countries of the world, flood control approach has been developed by constructing control structures such as dams and embankments to reduce the risks and damage caused by floods. However, as experience has shown, this is not possible by itself and it is in some cases non-economic. In order to cope with and reduce the risks of flood, various structural and non-structural approaches should be taken into account while considering all economic, social, political, and environmental indicators in the form of integrated management.

Therefore, it is necessary to gradually change flood control approaches to approaches such as flood management, integrated flood management (IFM), and finally, integrated risk management of flood. In this approach, one of the main problems of integrated flood management or any flood estimation is the lack of stationary in flood occurrence time due to the important factors in the previous decades. These factors have created huge and destructive floods in recent years by increasing the flood levels and the frequency of flood events. Therefore, considering the continuous changes in the parameters involved in flood production, monitoring of hydrological parameters and the establishment of a dynamic integrated flood management system is one of the most necessary measures. Therefore, in this research, the main objective is to study the effective parameters in flood formation and monitoring their changes over time and in non-stationary conditions for use in a dynamic flood risk management system.

**Research Question(s)** (maximum 400 words)

Please state your research question(s).

One of the main problems of integrated flood management or any flood estimation is the lack of stationary in flood time series due to factors such as climate change and infrastructure development. Regarding the continuous changes in the parameters involved in flood production, monitoring of hydrological parameters and the establishment of a dynamic integrated flood management system are among the most necessary measures. Determining the effective parameters in flood formation and monitoring their changes in the non-stationary conditions is considered as the most important step in this direction. In this research, after considering the adverse effects in the recorded flood time series and changes in precipitation parameters and water accumulation in the drainage basin, the following questions are expected to be answered:  
1. Given the probable trend in the mean and standard deviation of flood data in recent years, what is the need for continuous monitoring of effective parameters in flood production and the application of modern changes for the integrated flood management?  
2. Can flood data recorded in stationary time be an appropriate representative for predicting future floods?  
3. Are the results of statistical analysis of the flood in non-stationary conditions compatible with the results of monitoring the effective hydrological parameters in flood production and predicting flood values ​​using updated data?  
4. What is the effect of taking into account the impact of climate change and land use in predicting future floods on the values of key parameters determining the probable maximum flood? Do floods occurred in the past happen with a lesser return period in the future?

**Methodology** (4-6 paragraphs, maximum 1200 words)

Please indicate the specific methodology you plan to use. Your description may include an explanation of the analytical framework, data, or statistical techniques you would like to use. Please provide sufficient detail so that we can determine the feasibility of your research plan.

Determining the effective parameters in flood formation and monitoring their changes in non-stationary conditions is considered as the most important step in the integrated flood management section. Therefore, the following steps are needed to be taken to study the effects of stationary on the recorded flood time series and changes in precipitation parameters and water accumulation. In this regard, flood data should initially be predicted in the future by analyzing the recorded flood data. On the other hand, flood values ​​for the future are estimated by investigating changes in rainfall parameters and reservoir coefficient of the drainage basin and estimating them for the future and creating a Precipitation-Runoff model. Finally, by comparing the results obtained from the two methods, the effect of changes in future floods factors and accuracy of flood estimation can be studied.

Consequently, as mentioned above, two parallel sets of measures are undertaken to monitor and assess the effects of climate change and land use changes in drainage basin areas.

First, in the intended drainage basin, using the station data (if any) or the combination of satellite and terrestrial data, the historical time series of precipitation was obtained and the high precipitations were first selected from the mentioned data. Then, using the GCM models, the effects of climate change on heavy rains were studied and an estimate of high-intensity rains in the future is obtained. Then again, by using satellite imagery (Remote Sensing) and GIS, changes in the land use and land covers and land use forecasts are considered based on the development plan. Likewise, using satellite imagery, we can monitor changes in the amount and level of snow in different periods. Using the mentioned data, changes in the CN coefficient in the drainage basin are obtained. At this stage, precipitation data and land use data can be used as inputs of precipitation-runoff models in order to obtain a flood timeline in the future.

Furthermore, the flood data recorded in the present situation and the non-stationary conditions are studied and the existence of trend in the mean values ​​and standard deviation of flood data is investigated. Then, in order to analyze the flood in non-stationary conditions, the best statistical distribution is attempted to be fitted into the data set. In this stage, the statistical log-normal distribution can be used. Future flood forecasts can be predicted in different return periods and their values ​​can be obtained.

Finally, the results of the two methods are compared and used to modify and refine each other. The data is expected to be highly accurate for use in dynamic flood risk management systems. This method can be used to update the input data to the model at different times and to use the output results of the model for making better decision. The following process shows the intended steps briefly.

1. Monitoring
   1. Investigating the effects of climate change on extreme precipitations using GCM models
   2. Studying land use changes and land cover and change in snow level and change of CN index in drainage basin area using GIS and satellite imagery
   3. Application of paragraphs 1.1 and 1.2 in precipitation-runoff models and preparing flood time series.
   4. Estimating Flood Values
2. Estimation of flood values in the present condition and non-stationary conditions
   1. Investigating the existence of trends in mean values ​​and standard deviation of flood data observed
   2. Analysis of flood in non-stationary conditions by selecting appropriate statistical distributions such as the log-normal and ....
3. Comparison of two methods of monitoring and analysis of non-stationary conditions
   1. Conclusion
   2. Adjustments and Recommendations

**Contribution/Policy Implications** (2-4 paragraphs, maximum 800 words)

Please describe the expected output of your study and indicate how the results of your study can help solve the policy problem you described earlier.

Considering the continuous changes in the parameters involved in flood production, monitoring hydrological parameters and the establishment of a dynamic integrated flood management system are among the most necessary measures. Therefore, in this research, the main objective is to study the effective parameters in flood formation and monitoring their changes over time and in non-stationary conditions for use in a dynamic flood risk management system. In other words, due to the process of integrated risk management of flood, continuous changes that are due to climate change and development in drainage basin areas and past estimates should be reviewed. In this way, flood values ​​are re-estimated and the flood management cycle including hydrologic-hydraulic estimates, vulnerabilities, encountering, stationary and adaptability capacity, and ultimately flood risk are reviewed and reported to the responsible managers for major actions. Therefore, it is expected that the results of this study indicate the necessity of flood monitoring and analysis in non-stationary conditions and the inaccuracy of the data derived from the stationary hypothesis. In other words, the results of this study confirm the necessity of evaluating these data in non-stationary conditions. On the other hand, the need for continuous monitoring and the importance of revising estimates and calculations in the integrated management cycle, due to its process-based nature, shall be well represented. Using the results of this study, it can be expected that more reliable data will be used in flood risk management and, therefore, the risk parameters and flood vulnerability are presented with more accurate estimation for making appropriate decisions.