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Exploring Farm Pond Patterns In Ahmednagar: Enhancing Agriculture Through Protective Irrigation Strategies

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Abstract:

This research delves into Ahmednagar district, a drought-prone region in Maharashtra, to investigate the spatial distribution and impact of farm ponds on agricultural development, water resources, and groundwater dynamics. The primary aim is to assess the role of farm ponds in alleviating water scarcity for horticultural crops and their influence on the net irrigated area. Utilizing field surveys, questionnaires, and interviews, the study gathers primary data on farm pond characteristics. Among approximately 9798 farm ponds constructed from 2005 to 2015, a 10% sample is analyzed to comprehend their role in agricultural development. Statistical analysis reveals that farm ponds serve as vital irrigation tools, ensuring a reliable water source and contributing to increased crop production. Spatial distribution analysis categorizes tehsils into various density levels, with Rahata, Nagar, and Karjat showing notably high densities. This categorization sheds light on the diverse contributions of farm ponds to the irrigation landscape. Exploring the proportion of irrigated area by farm ponds relative to Net Irrigated Area (NIA) at different levels, the study unveils an average proportion of 50.53%, with a standard deviation of 19.33%. These findings underscore the substantial impact of farm ponds on agricultural productivity and water security in the region. The abstract highlights farm ponds as crucial solutions to water scarcity challenges, offering valuable insights for policymakers and agricultural extension workers to implement sustainable water resource management strategies in drought-prone areas. Furthermore, the study considers potential drawbacks of lined farm ponds, such as hindering rainwater percolation and impacting groundwater resources, contributing to a comprehensive understanding of the implications of farm pond adoption in agricultural landscapes.

Keywords: farm ponds, irrigation, water resources, Ahmednagar district, droughts etc.

Introduction:

"Ahmednagar district is one of the drought-prone regions in Maharashtra state." (IPCC, 2007) [3] The extremity of droughts has its long-term effects on the Agricultural sector as it does not allow the capital formation and hence farmers become a vulnerable community. The modern agricultural farming methods such as horticultural crops contribute significantly in the capacity building of farmers especially in drought prone areas. Shroff S. and Kajale J. stated that, "Horticulture in the country and Maharashtra in particular has tremendous potential while infrastructure bottlenecks, absence of post-harvest management and other logistics can act as major constraints." [6] Therefore, the water harvesting structures like farm ponds can act as a life saviour of horticultural crops in the state of water scarcity in drought prone areas. "Considering the fast decline of irrigation potential and increased demand for water from different sectors, many initiatives have been introduced to conserve the scarce water resources in India. One of the methods introduced to save water consumption in agriculture was drip method of irrigation (DMI)." [4] The drip irrigation method of modern irrigation techniques requires a source of water. The farm-pond is proving to be a secure water source for growth of Horticultural crops.

According to Pooja Prasad and Milind ohani in their research article, "It is unlikely that a desired state of equilibrium can be achieved without regulation because economic incentives continue to drive farmers to invest in farm-ponds even as groundwater levels fall thereby leading to the tragedy of the commons." [5] "The role of farm pond density in groundwater recharge" by Green, W. C., et al. (2006) in the journal Hydrogeology Journal evaluates the impact of farm pond density on groundwater recharge rates. The study found that watersheds with higher densities of farm ponds had lower

groundwater recharge rates, due to reduced infiltration of rainwater into the ground. [7] Therefore, the presented study entitled "Exploring farm pond patterns in Ahmednagar: Enhancing agriculture through protective irrigation strategies" is undertaken.

Study Area:

Ahmednagar district is selected as the study area in the state of Maharashtra. The district is spread between $18^0$10' to $20^0$00' North Latitude and $73^0$30' to $75^0$37' East Longitude. [1] (Figure 1). The total geographical area of the district is 17048 sq. km. having 14 tehsils. [2] The district lies in the rain shadow zone of the western ghat. The distribution of the rainfall is very uneven and average annual rainfall received is 583.5 mm. About 75% of the annual rainfall is received during the southwest monsoon season

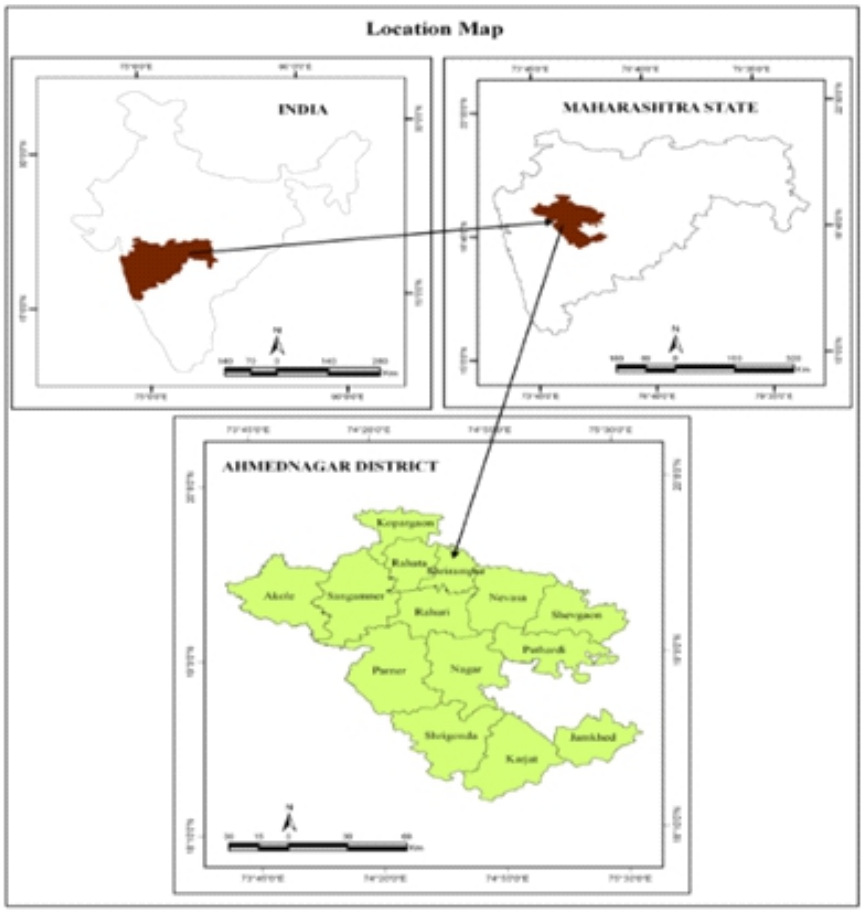

Figure No. 1: Location Map of Study Area

Objective:

The present study's main objectives are,

1. To investigate the spatial distribution of farm ponds in Ahmednagar district and
2. To assess farm ponds' influence on net irrigated area, enhancing water resources for agriculture in Ahmednagar district.

Database and Methodology:

The present study is based on primary data. The primary data is collected through field-survey using questionnaire and personal interviews. The required data and information about various factors

like number of farm ponds, respective location, shape and sizes, irrigation facilities, land data and other related information etc. is collected. The detailed database and methodology are presented in the flowchart (Figure 2).

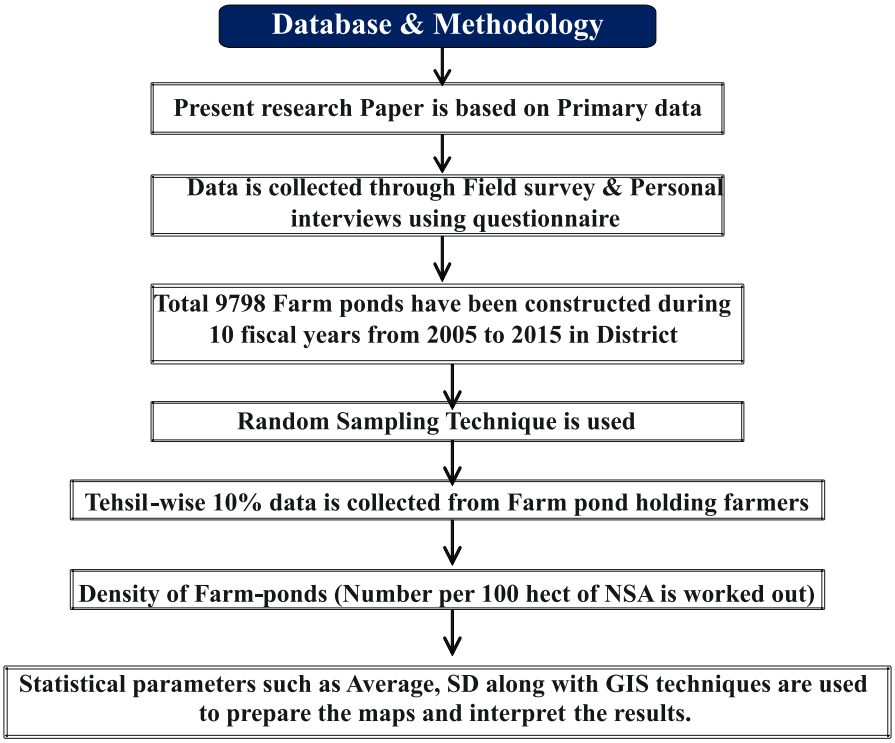

Figure No. 2: Flowchart for database and Methodology

As per available data from the office of agricultural of Ahmednagar district, about 9798 farm-pond have been constructed during ten fiscal years from 2005 to 2015 in the 14 tehsils of the district. The 10% sample of the same has been used to understand agricultural development based on farm-pond.

Results and Discussion:

Farm ponds have become an essential irrigation tool in many regions, providing a reliable source of water during dry spells. By collecting and storing rainwater, farm ponds enable farmers to supplement their irrigation needs, increasing and stabilizing crop production. Research has shown that farm ponds are particularly beneficial in the study region, where water resources are limited. The spatial distribution of farm ponds in Ahmednagar district is shown in the table (Table 1) and the map (Figure 3) in the form of levels of number of constructed farm-ponds per 100 hect of NSA.

Table No. 1: Density of Farm-Ponds (Number per 100 hect of NSA)

Density of Farm Ponds	Scale	Tehsils	% tehsils
Very Low	Below 30	Shrirampur	**7**
Low	30-35	Akole, Kopargaon, Parner	**21**
Medium	36-40	Newasa, Shrigonda	**14**
High	41-45	Sangamner, Shevgaon, Pathardi, Rahuri, Jamkhed	**37**
Very High	Above 45	Rahata, Nagar, Karjat	**21**
District		**14**	**100**
		Average:41 SD:7	

(Source: Compiled by researcher based on primary data)

The average proportion of constructed farm-pond per 100 hector NSA is 41. Shrirampur, Akole, Kopargaon and Parner tehsils have very low and low (upto 35) level of density of farm-ponds, while Newasa, Shrigonda, Sangamner, Shevgaon, Pathardi, Rahuri, and Jamkhed tehsils have medium to high (36-45) density and Rahata, Nagar and Karjat falls under very high (Above 45) density of farm ponds.

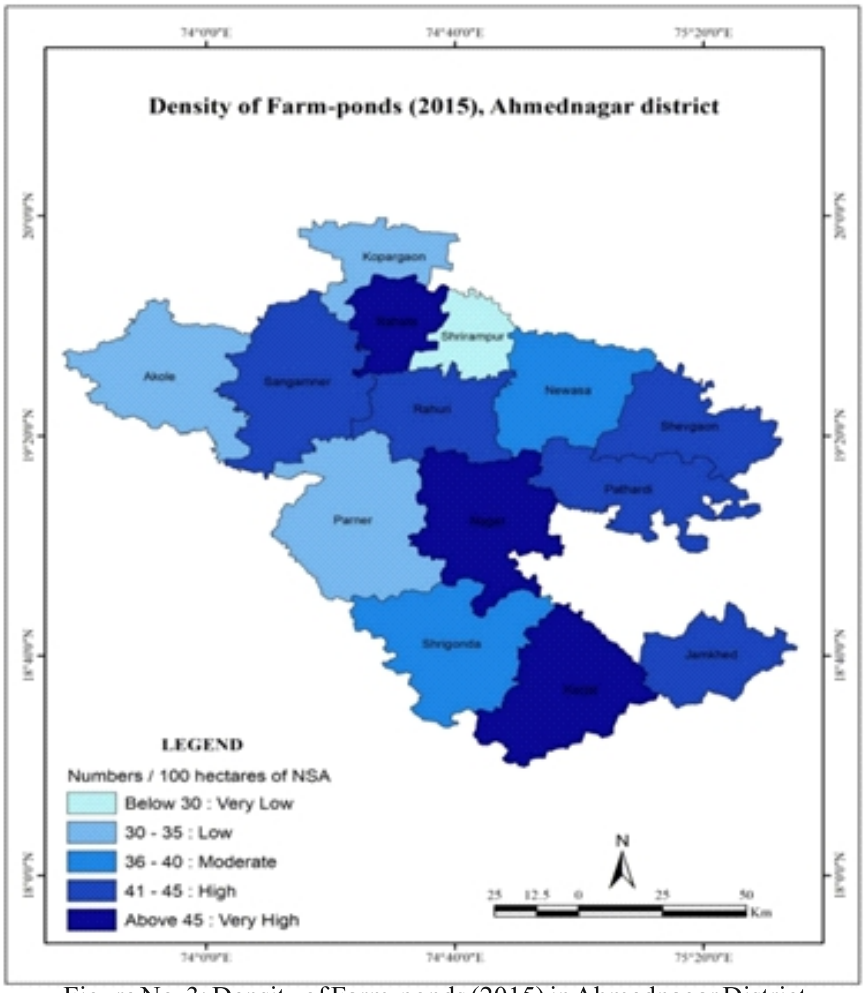

Figure No. 3: Density of Farm-ponds (2015) in Ahmednagar District

In the study region, farm ponds are particularly important in the tehsils of Rahata, Nagar and Karjat, which have a very high density of farm ponds. This suggests that farmers in these tehsils have recognized the benefits of farm ponds and are investing in this technology to improve their crop production.

Half of the tehsils in the study region have a high and very high density of farm ponds. These tehsils have traditionally relied on farming, have fertile land and adequate water resources. However, in some tehsils, such as Newasa, Shevgaon, and Rahuri, there is no guarantee of canal water rotation. Therefore, farmers in these tehsils have built a high number of farm ponds (35 to 45 per 100 hectares) to ensure a reliable supply of water for irrigation.

Farm ponds can play a significant role in improving agricultural productivity and water security in the study region. By promoting the construction and use of farm ponds, policymakers and agricultural extension workers can help farmers to adapt to climate change and produce more food with less water.

Table No. 2: Proportion of Irrigated area by Farm-pond to Net Irrigated Area (NIA)

Level of Irrigated area by Farm-pond	Scale of % to NIA	Irrigated area by Farm-Pond	
		Tehsils	% tehsils
Very Low	below 25.00	Shrirampur	7.14
Low	25.00-40.00	Kopargaon, Rahata, Newasa, Rahuri	28.56
Medium	40.01-55.00	Akole, Sangamner, Shrigonda	21.46
High	55.01-70.00	Shevgaon, Parner	14.28
Very High	above 70.00	Pathardi, Nagar, Karjat, Jamkhed	28.56
District		**14**	**100**
		Average:50.53 SD:19.33	

(Source: Compiled by researcher based on primary data)

The table (Table 2) and map (Figure 4) presents a detailed breakdown of the proportion of irrigated area contributed by farm-ponds relative to the Net Irrigated Area (NIA) across different levels. The first column categorizes the levels of irrigated areas by farm-pond, ranging from "Very Low" to "Very High," with corresponding scales of percentage to NIA. The second column identifies the Tehsils (sub-districts) falling within each level, providing a geographical context to the data. For instance, Tehsils like Shrirampur fall under the "Very Low" category, with a scale below 25.00%. In contrast, Tehsils such as Pathardi, Nagar, Karjat, and Jamkhed are classified as "Very High," boasting a scale above 70.00%.

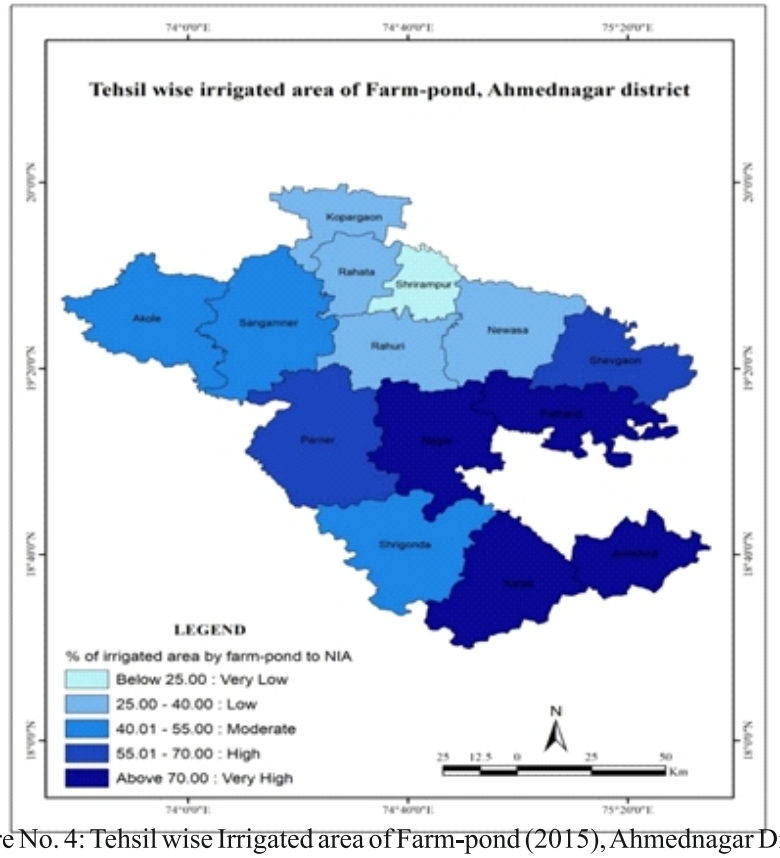

Figure No. 4: Tehsil wise Irrigated area of Farm-pond (2015), Ahmednagar District

The third column showcases the percentage of Tehsils within each level, offering insights into the distribution of farm-pond-based irrigation across the region. Notably, Tehsils in the "Low" category, including Kopargaon, Rahata, Newasa, and Rahuri, collectively contribute 28.56% to the overall irrigated area by farm-ponds. Meanwhile, the "Medium" level Tehsils, such as Akole, Sangamner, and Shrigonda, account for 21.46%. Interestingly, the "Very High" category, represented by Tehsils like Pathardi, Nagar, Karjat, and Jamkhed, also contributes a significant 28.56% to the total irrigated area.

The district-level summary at the bottom of the table consolidates the data, indicating that the overall average proportion of irrigated area by farm-ponds to NIA is 50.53%, with a standard deviation of 19.33%. This district-level overview provides a comprehensive snapshot of the distribution of farm-pond-based irrigation, emphasizing the varying contributions across different Tehsils and levels within the region.

The photo (Figure 4) shows a typical farm pond in the study region. The pond is lined with polyethylene (PE) to prevent water seepage and is fenced with galvanized iron chain link fence to protect it from livestock.

Lined farm ponds, while offering some benefits in terms of water conservation and prevention of soil erosion, can also have certain disadvantages that impact groundwater resources. First, lined ponds prevent rainwater percolation into the ground, which is a crucial process for replenishing groundwater aquifers. By impeding this natural recharge process, lined ponds can contribute to groundwater depletion, especially in areas with limited surface water sources.

Figure No. 4: Farm pond with Poly-ethane (PE) lining and Galvanized Iron chain link fencing

Conclusion:

In conclusion, the research conducted in Ahmednagar district illuminates the pivotal role of farm ponds as a strategic intervention to address water scarcity challenges in drought-prone regions. The study reveals a substantial spatial distribution of farm ponds, particularly evident in tehsils like Rahata, Nagar, and Karjat, underscoring their importance in enhancing agricultural productivity. Statistical results indicate an average density of 41 farm ponds per 100 hectares of Net Sown Area

(NSA). Furthermore, the study delves into the proportion of irrigated area contributed by farm ponds to Net Irrigated Area (NIA), presenting a district-wide average of 50.53%, with a standard deviation of 19.33%. These findings emphasize the positive impact of farm ponds on irrigation practices while acknowledging potential challenges such as groundwater recharge rates and the need for regulated development. Overall, the research underscores the significant potential of farm ponds as a sustainable water management strategy for agricultural development in drought-prone areas like Ahmednagar district.

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