**Smart Villages and Rural Development Index of YEIDA Region**

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**Abstract.** The YEIDA (Yamuna Expressway Industrial Developmental Authority) region of Uttar Pradesh comes under the implication of sustainable rural development area by the execution of government projects inspired by PURA (Providing Urban amenities for Rural Areas) proposed by Dr.A.P.J. Abdul Kalam. This research study investigated 6 villages of Yeida region namely Aurangpur, Reelaka, Gunpura, Jaganpur Afjalpur, and Dankaur in the view of regional development by urbanization. To measure the sustainable growth, increase in employability for rural areas, improving literacy rate, providing urban amenities and overall development and assessment, SWOT (Strength, Weaknesses, Opportunities, and Threats) analysis was carried out defining 20 parameters. The villagers of the proposed six villages were surveyed using the questionnaire developed for measuring the indices covering literates and illiterates. The local people responded to the conducted survey and sustainable rural index was measured using likert scale. All the villages showed positive value for Rural Development Index (RDI) and Aurangpur had the highest impact with a score of 14.28. The research projected positivity in the urbanization of the rural areas of YEIDA region.

**Keywords:** Smart Village. CSA. CSV. SWOT.YEIDA

# Introduction

The green economy and digitalization of villages is a major research topic throughout the world [1]. It offers positivity in knowledge development leading to green growth, and economic stability that would reduce the poverty. Furthermore it provides the rural community to compete with technology for developing their local rural business capabilities, enhanced productivity, and employability [1]. It had been observed that Indonesia projected increased economic growth in rural community by strengthening the corporate social responsibility [1] which resulted in economic recovery. This pushed the country to become a host in G20 presidency [1]. The country suffered from negative impact by using non-renewable energy resources which was then balanced by Indonesia’s abundant natural resources. It was concluded from research that the enhanced GDP growth even led to environmental damage. The Indonesian [1] investigation pronounced that the rapid urbanization could lessen the impact of pollution levels by innovative technicalities and ecological modernization [1]. The studies on climate smart villages (CSV) of Myanmar reports that about 44% of the global population lives in rural regions as stated by World Bank [2]. The survey by researchers in Myanmar revealed that the CSVs had increased cash inflows through agricultural activities in 2020. This occurred during the pandemic period (2020) and it was higher than that [2] of pre pandemic period (2018).

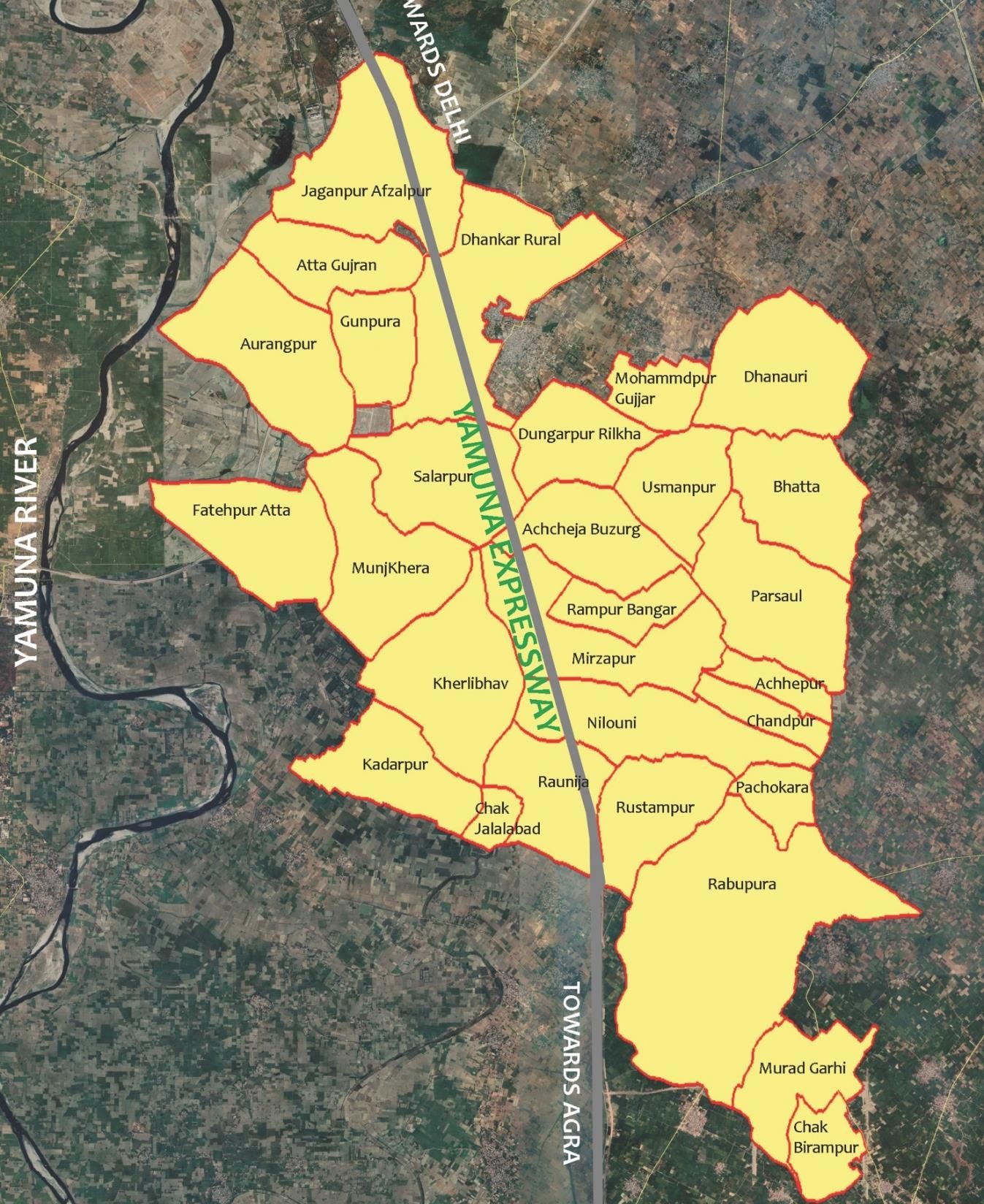
The Myanmar Government had increased the floor price of rice set [2] during the pandemic period. It proved that the rural development is the backbone of global economic growth. The smart village conceptualization in China’s report expose that [3] 551.62 million people live rural areas and 236 million people live and work in cities. But the urbanization reached 60.6% by 2020 [3]. This fact ensures that the quality of development depends on the sustainable rural development of China [3]. Chinese identified a gap between urban and rural development and realized that the rural areas are trapped in poverty. The Chinese [3] define five sub-systems for sustainable smart villages namely [3] the strategic subsystem, the social subsystem, the economic subsystem, the resource and environmental sub system and the information subsystem. These subsystems are supported by solutions provided by information technology. The Chinese rural [3] revitalization had been enhanced by planning for smart village in the country. The investigations on Southern Moravia shows that the development of smart village [4] is analogous to the concept of sustainability. The findings of the researchers of Moravia concluded that the accessibility of the digital technology is not the hindrance for smart village, but the lowered qualification and conservatism of the rural people is [4]. Also the studies recommended to increase the level of digital literacy in rural areas. The Moravian researchers also conclude that the digital technologies should [4] aim at developing the local business, education, health, social welfare, and preventing the exclusion of senior citizens and the disabled. This definition is also extended to e-learning, e-health, e-administration, transport, social services, bio-based economy, renewable energy, rural tourism, and circular economy. Other studies on projected CSV (Climate Smart Village) model [5] reported that by involving the rural and local people in decision making process can make them adapt to climate change (CC). This type of involvement of the local residents lead to identification and addressing environmental and socio economic challenges [5]. This holistic approach had led to climate –smart village (CSA) [5]. Prinsloo et.al., reported that [6] huge population from this globe lives in geographically isolated rural areas. The researchers further claim that these disparate communities must be given equality in accessing the energy for developing the economy [6]. The sub-saharan region of Africa was accessed for [7] climate smart villages. The research findings reported that the food security and livelihoods of the African people is vulnerable. The Africa is suffering from droughts, extreme heat and the population mainly depends on rain fed agriculture for livelihood [7]. It was then by CCAFS (Climate Change, Agriculture, and Food Security) developed the CSA for CSV [7]. The country then started invested in educating the rural people to accelerate the agriculture by organic farming [7]. This was followed by training and capacity building programs for the farmers along with subsidy [7] and credit for sustainable village development. Kessler et.al.,(2019) projects the fact [8] that the world has 795 million hungry people it is expected to go high as 2 billion by 2050. The researcher narrates that there is an urgent need for revolution in global food and cultivation to meet the food requirement [8]. The food production and cultivation system needs scaling up to achieve the goal of CSA which faces challenges by opposing socioeconomic priorities and tradeoffs on temporal scales [8] in sub – Saharan Africa regions. The CSA followed in Africa [8] does not need newer technologies for agriculture but harmony and synchronization of interventions in agriculture. This may lead to management of short and long term goals of food production. The [9] South Asian region is susceptible to vulnerable climate change and thus faces challenges with food security and stability by millions of the population as reported by IPCC in 2007. The participation of women in agriculture and their empowerment had become a major issue in reaching sustainability in food production and rising economy [9] in India. The research studies on gender empowerment in climate change adaptation is limited [9].

India has been found to develop CSVs in Bihar and Haryana with “Water Smart”, “Micro-irrigation smart”, “Nutrition Smart”, and “Carbon and Energy Smart”[9]. Both Bihar and Haryana has been found to have a rise in temperature by 1.5˚ to 2.5˚by 2030 [9]. It was observed that both the states had increased food productivity on adapting CSA [9]. The Smart Village (SV) was a new concept in India which was developed by Indian researchers [10] N.Viswanandham and Sowmya in 2010. The smart village model was conceptualized based on the term “Access Information for Everybody” by providing ICT [10]. The researchers and reformers N.Viswanandham and Sowmya along with Dr.A.P.J. Abdul kalam, the 11th President of India framed PURA (Providing Urban Facilities for Rural Areas) focusing on 4 elements namely physical, electronic, knowledge and economic connectivity [11]. PURA was aimed at developing rural communities. The Indian government launched Sansad Adarsh Gram Yojana (SAGY) for holistic development of rural people [11]. The Indian government [11] aimed at having developments in the fields of personal, human, economy, environment, basic amenities and services, social security and good governance by democracy. The PURA project was then modified by Rural Development Minister Jairam Ramesh [11] as “Syama Prasad Mukerji Rurban Mission”. About Rs. 5142 Crores were allotted for this scheme. Rurban areas refer to a cluster of 20 villages. The clusters consisted of gram panchayats having 25,000 to 50,000 rural people. It was led by digital India mission providing skills, mobile health units, school education, sanitation, water supply, solid and liquid waste management, drainages, streetlights, roads, transport, LPG connections, and digital literacy [11]. The Indian Government defines [11] smart village as follows: “A Greenfield smart village represents development of a community by growth in latest digital technologies followed by global connectivity and reach which is supported by basic amenities such as housing, sewage, electricity, schooling, health care facilities, transportation, job creation, and revenue generation”. In India the circular economy also exists where by the population from the rural areas migrate to urban areas for jobs and would return to their native [11] after couple of months or years. This would reduce the financial stress on rural community. India reports about 100 – 150 million people [11] involved in circular migration and the villagers were provided with better income opportunities. It has been found that development is a multifaceted process [12] that changes social structure and community attitudes which would improve economy by focusing on income disparity, and alleviate poverty. The development of technologies for smart villages had both [13] advantages and disadvantages. The technologies such as AI, IOT, sensors, and data analysis impacts [13] efficiency, productivity, and safety. But their integrity with community and environment [13] is a big question to be researched. This research is inspired from studies by Niloofar et.al, [14] on the lessons learnt from the Haji village of Iran involving sustainability on rural development. This investigation on Yeida covers 6 smart villages including Dunkaur, Jaganpur Afjalpur, Gunpura, Reelaka, Aurangpur and Raunija and the sustainable rural index was measured for the same.

# The YEIDA Region

Yamuna Expressway Industrial Development Authority (YEIDA) is engaged in the development of regions notified under its master plan. Approximately 334 villages of District Gautama Buddha Nagar, Bulandshahar, Aligarh, Mahamaya Nagar (Hathras), Mathura and Agra are notified under YEIDA. In its endeavor to develop Smart Villages, YEIDA has initiated preparation of the Detailed Project Report for 29 villages, including base map surveys, beautification, and infrastructure upgradation and shall then carry out a bidding process for selection of the execution agency.

The 29 villages lie along the Yamuna Expressway on either side. These villages are now surrounded by planned sectors of the Yamuna Expressway Industrial Development Area (YEIDA). The agricultural land belonging to the villages has now been acquired by Yamuna Expressway Industrial Development Area (YEIDA), hence the character of the villages will change from rural to urban.



**Fig. 1.** Cadastral map of 29 revenue villages under the study, falling in YEIDA

The figure 1 shows the cadastral map of YEIDA region of Uttar Pradesh. The study region lies within proximity of the Yamuna Expressway, the most hi-tech highway in India built with an intention to provide a safe, secure and convenient way to travel between Agra & Greater Noida (from Greater Noida to Kuberpur on NH 2 towards Kanpur and Agra); boasting the state art of “Intelligent Transportation Systems”, to facilitate these objectives. It is 6-lane and 165 km long and is one of India’s longest controlled-access expressways. It was inaugurated in August 2012. The total estimated project cost was ₹128.39 Billion at the time of its conception.

The researched villages have no existing networks of the physical infrastructure components such as water supply, sewage, sanitation, drainage, solid waste management, parks and playgrounds, street lighting etc. However, electricity and an essential road network has been provided to all the villages. The proposed smart village scheme by the Government of India (GOI) was substantiated by SAGY initiatives as shown in figure 2. (Saansad Adarsh Gram Yojana)



**Fig. 2.** Examples of SAGY initiatives

As mentioned earlier, SAGY is an extension of PURA Scheme proposed by Dr.A.P.J. Abdul Kalam, the missile man of India. The villages were provided with enhanced facilities shown in figure 2. This research investigation involving the case study of six villages discussed in this paper is from YEIDA region as stated earlier. These six villages are developing region in the NCR (National Capital Region) of Uttar Pradesh. The villagers started migrating towards urban region for jobs and livelihood. The government came up with converting the agricultural lands from the farmers to residential apartments and providing them with all amenities by both privatization and government projects. Now the urbanization of the villages had led to employability and development of the villagers. This project had made the villages to develop all kinds of social and economic needs and the urbanization had led to develop a hybrid village having farms and urban dwelling units. This research came up with SRDI having positivity and representing development and support from the Uttar Pradesh people. The government had been supported by positive impact of smart and sustainable villages.

# The Research Methodology

The six villages chosen for the research were Dunkaur, Jaganpur Afjalpur, Gunpura, Reelaka, Aurangpur, and Raunija of YEIDA region of NCR (National Capital Region) where the Smart Village scheme was implemented. In each village 20 people were selected randomly covering both literates and illiterates.

The first questionnaire was framed with 25 set of questions exploring the social and economic needs of the villages with government schemes focusing on community development, health care services, educational facilities, skill development, support to the farmers, traditional crafts, financial services, banking facilities, employability and trade and commerce centres. The second set of the questionnaire was prepared to survey the strengths, negativity, urbanization, and threats to existing village structure. The relative frequency, index, and weighted reliability were calculated for the 6 villages. Finally Sustainable Rural Development Index (SRDI) was calculated. The answers were given weightage based on “Likert Scale” values ranging from 0 to 5. The weightage was given to varied responses indicating social and economic needs of the research parameters.

The Sustainable Rural Development Index (SRDI) was the average of the twenty indicators proposed in the study [14].

The SRDI = (1)

In the above equation “S” represents the Strength, “U” represents the Urbanization, “N” represents the Negativity, and “T” represents the Threats. The positive of SRDI represents the sustainable development and the negative value indicates unsustainable.

# Results and Discussions

The research on 6 villages of the YEIDA village exposed the pros and cons of the implementation of the SMART village concept by the government. So far the villages have responded positively. As explained earlier there were 5 tables indicating social and economic needs, SWOT analysis, effective needs, influence factor, and weighted reliability. A total of 30 tables are available in the following link:

<https://drive.google.com/drive/folders/1HNr9aFU3Jv0gVBzWC6NH5dCFMuyfbjbo?usp=sharing>.The digitalization of the villages, skill development by government schemes, employment, business facilities, and environmental development were studied by the survey, by framing basic questions and the responses of the villagers were recorded by “Likert Scale”. The education facilities, employability, information on government schemes, sustainable practices adopted, transportation, medical units, banking facilities, solid waste management, and drainage facilities were assessed through questionnaire. The urbanization and its advantages and threats were analysed by SWOT analysis by surveying on six villages namely Dunkaur, Jaganpur Afjalpur, Gunpura, Reelaka, Aurangpur and Raunija. The SRDI (Sustainability Rural Development Index) was found using the equation 1 for six villages. As reported by table 1, the villagers responded that the infrastructure, electricity, roads and water supply are the basic amenities and had been provided by the government. The villagers viewed that employability, urbanization, and ICT facilities are in developing stage. The survey came up with the negative aspects of threats to traditional farming, community cohesion, lack of digital literacy, and unemployment for unskilled labourers. However there was not much difference in survey results of all the six villages which was found to reflect in influence factor, relative frequency, index and weighted reliability. The SRDI allowed the researcher to have community participation in weighing the government projects on rural development and maintaining smart and sustainable villages. The smart village people were involved in SWOT analysis and the index projected the view and direction that has to be adopted to ensure successful implementation of the government schemes. The table 1gives the weighted reliability of the Village Aurangpur.

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| --- | --- | --- |
|  | **SWOT Analysis : Village AURANGPUR** | **Weighted**  **Reliability** |
|  | **STRENGTHS OF SMART VILLAGE** |  |
| 1 | The SMART Village Project has effectively improved infrastructure such as roads, electricity, and water supply. | 4.465 |
| 2 | The project has successfully enhanced digital connectivity, providing high-speed internet access to villagers | 0.1375 |
| 3 | The SMART Village Project has contributed significantly to improving access to quality education through technology and innovative teaching methods | 0.385 |
| 4 | Villagers have experienced enhanced economic opportunities through entrepreneurship support and skill development programs under the SMART Village Project | 0.19 |
| 5 | The project has led to the establishment of improved healthcare facilities and access to telemedicine services, positively impacting villagers' health | 0.4125 |
|  | **NEGATIVITY OF SMART VILLAGE** |  |
| 6 | The SMART Village Project has caused disruptions in existing infrastructure (e.g., roads, utilities). | 0.13125 |
| 7 | The project has widened the digital divide within the village, leaving certain segments of the population behind in terms of access to technology. | 0.13125 |
| 8 | Implementation of the SMART Village Project has led to challenges in accessing quality education or has negatively impacted traditional teaching methods. | 0.275 |
| 9 | Some villagers have experienced economic displacement or loss of livelihoods due to changes brought about by the SMART Village Project. | 0.135 |
| 10 | There have been negative consequences for healthcare access or quality as a result of the SMART Village Project. | 0.2625 |
|  | **URBANIZATION & EMPLOYMENT** |  |
| 11 | The urbanization efforts under the SMART Village initiative have led to a noticeable increase in job opportunities within the village. | 0.19 |
| 12 | The SMART Village project has attracted a diverse range of industries and businesses, contributing to job creation and economic growth. | 0.385 |
| 13 | Skill development programs initiated as part of the SMART Village project have effectively equipped villagers with the necessary skills to access new job opportunities. | 0.591 |
| 14 | The SMART Village project has provided significant support and resources for local entrepreneurs, leading to the creation of new businesses and employment opportunities | 4.3875 |
| 15 | Overall, villagers feel that the urbanization efforts under the SMART Village initiative have positively impacted employment opportunities and economic prospects within the community. | 4.68825 |
|  | **THREATS TO VILLAGERS** |  |
| 16 | How concerned are you about the potential loss of privacy for villagers due to increased monitoring and data collection in smart village technologies? | 0 |
| 17 | To what extent do you perceive the risk of social exclusion for villagers who may not have access to or be proficient with smart technologies? | 0 |
| 18 | How concerned are you about the potential for job displacement or changes in traditional livelihoods as a result of automation and technology integration in smart village development? | 0.1435 |
| 19 | In your opinion, how much of a threat do you believe misinformation and manipulation of digital platforms pose to villagers' well-being and decision-making in smart village environments? | 0.07175 |
| 20 | To what degree do you perceive the potential for increased dependency on technology as a threat to the self-sufficiency and resilience of villagers in smart village settings? | 0.07175 |

**Table 1.** Calculation of Weighted Reliability.

# Conclusions

The index SRDI was concerned with multiple factors such as average rating, relative frequency, index, influence factor, and weighted reliability. The selected villages were surveyed using survey form filled by 20 individuals per village and the assessment was done by “Likert Scale.” Among the selected villages, the village Aurangpur stood first with SRDI of 14.28 followed by Reelaka (11.39), Jaganpur Afjalpur (10.4) , Gunpara (9.95), Dankaur (9.53), Raunija (9.45). The SRDI index evaluated the implementation of SMART village concepts based on twenty attributes and it was found that apart from Aurangpur having SRDI 14.28, the other villages had almost constant values. This projected the view that in YEIDA region, the community from all villages face the same positivity and negativity on implementing the SMART village concepts. The Government Project SAGY needs to be triggered and even though the process started in 2012, the villages are still under development. More focus is needed on development of villages based on socio –economic needs, ICT, IOT, CSA. It had been observed that with this planning developed by government, the migration of rural population to urban areas had been reduced to greater extent as the villagers are offered other employment in construction industry. But the major threat faced by the rural regions of YEIDA is the farm lands are getting diminished by construction of smart villages having apartments in those lands. This leads to hybrid culture with threat to traditional occupation of the rural people. The traditional crafts and jobs are under serious threat due to urbanization. These facts were projected from the investigation and it was reported that the influence factor was constant and found to be around 0.5. The research index encourages the SMART village conceptualization and it recommends to maintain and preserve the tradition along with ultra-modernization of villages. The survey sheets are available in the following url: <https://drive.google.com/drive/folders/1KuDbFpUR-cPntQ5LDpAeGDxgNGw4Ttea?usp=sharing>

# References

1. Ayu Purnamawati IG, Yuniarta GA, Jie F (2023) Strengthening the role of corporate social responsibility in the dimensions of sustainable village economic development. Heliyon 9:1–12. https://doi.org/10.1016/j.heliyon.2023.e15115
2. Barbon WJ, Myae C, Vidallo R, et al (2022) The mitigating role of climate smart villages to the impacts of COVID-19 pandemic in the Myanmar rural communities. Curr Res Environ Sustain 4:. https://doi.org/10.1016/j.crsust.2022.100152
3. Zhang X, Zhang Z (2020) How do smart villages become a way to achieve sustainable development in rural areas? Smart village planning and practices in China. Sustain 12:1–20. https://doi.org/10.3390/su122410510
4. Vaishar A, Št’astná M (2019) Smart Village and Sustainability. Southern Moravia Case Study. Eur Countrys 11:651–660. https://doi.org/10.2478/euco-2019-0036
5. Sanogo D, Ndour BY, Sall M, et al (2017) Participatory diagnosis and development of climate change adaptive capacity in the groundnut basin of Senegal: Building a climate-smart village model. Agric Food Secur 6:1–12. https://doi.org/10.1186/s40066-017-0091-y
6. Prinsloo G, Dobson R, Mammoli A (2017) Smart Village Load Planning Simulations in Support of Digital Energy Management for Off-grid Rural Community Microgrids. Curr Altern Energy 2:2–18. https://doi.org/10.2174/2405463102666171122161858
7. Ouédraogo M, Houessionon P, Zougmoré RB, Partey ST (2019) Uptake of climate-smart agricultural technologies and practices: Actual and potential adoption rates in the climate-smart village site of Mali. Sustain 11:. https://doi.org/10.3390/su11174710
8. Jagustović R, Zougmoré RB, Kessler A, et al (2019) Contribution of systems thinking and complex adaptive system attributes to sustainable food production: Example from a climate-smart village. Agric Syst 171:65–75. <https://doi.org/10.1016/j.agsy.2018.12.008>
9. Hariharan VK, Mittal S, Rai M, et al (2020) Does climate-smart village approach influence gender equality in farming households? A case of two contrasting ecologies in India. Clim Change 158:77–90. <https://doi.org/10.1007/s10584-018-2321-0>
10. Aziiza AA, Susanto TD (2020) The Smart Village Model for Rural Area (Case Study: Banyuwangi Regency). IOP Conf Ser Mater Sci Eng 722:. <https://doi.org/10.1088/1757-899X/722/1/012011>
11. Viswanathan, S. P., Chellian, S. K., Varghese, S., & Semeon, J. (2021). Sustainable water for smart villages - A case study. Smart Villages: Bridging the Global Urban-Rural Divide. https://doi.org/10.1007/978-3-030-68458-7\_21
12. Purnamasari R, Hasanudin AI, Zulfikar R, Yazid H (2024) Do internal control and information systems drive sustainable rural development in Indonesia? J Open Innov Technol Mark Complex 10:. https://doi.org/10.1016/j.joitmc.2024.100242
13. Jakobsen K, Mikalsen M, Lilleng G (2023) A literature review of smart technology domains with implications for research on smart rural communities. Technol Soc 75:. https://doi.org/10.1016/j.techsoc.2023.102397
14. Hashemi N, Ghaffary G (2017) A Proposed Sustainable Rural Development Index (SRDI): Lessons from Hajij village, Iran. Tour Manag 59:130–138. https://doi.org/10.1016/j.tourman.2016.07.021