International Journal of Atharva
Vol. 3, No. 1, February 2025. Pages: 1-10
ISSN: 3021-9205 (Print) ISSN:3021-9299 (Online)
DOI: https://doi.org/10.3126/ija.v3i1.76000

Human Resource Development for Sustainable Construction, Disasters Risk Reduction and Climate Change Adaptation

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Received: December 10, 2024 Revised & Accepted: February 24, 2025

Abstract

Human Resource Development (HRD) plays a critical role in achieving sustainable construction, disaster risk reduction (DRR), and climate change adaptation (CCA) in Nepal. As a country highly vulnerable to earthquakes, landslides, and climate-induced hazards, Nepal requires a skilled workforce capable of developing resilient infrastructure, implementing disaster preparedness strategies, and adopting climate-adaptive solutions. This article explores the current status, challenges, and future directions of HRD in these sectors, emphasizing technical and vocational training (TVET), policy and institutional frameworks, capacity-building programs, and community-based skill development.

Despite policy advancements, including the National Building Code (NBC, 2020), National Adaptation Plan (NAP), and Technical and Vocational Education and Training (TVET) programs, significant gaps remain in implementation, institutional coordination, and equitable access to training opportunities. Key challenges include limited skilled workforce, weak

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enforcement of construction standards, insufficient funding, and lack of climate-responsive education. Additionally, rural and marginalized communities often have limited access to HRD opportunities, further exacerbating vulnerabilities.

To address these gaps, Nepal must adopt strategic HRD interventions, such as integrating DRR and CCA into education, expanding technical training in sustainable infrastructure, strengthening policy implementation, and leveraging digital technologies for capacity-building. Moreover, public-private partnerships, research on climate-resilient materials, and inclusive skill development programs will be essential in building a competent workforce capable of driving sustainable development and disaster resilience. By prioritizing HRD as a key enabler, Nepal can foster a skilled, adaptive, and resilient workforce that contributes to a sustainable and disaster-resilient future.

Keywords: Human Resource Development (HRD), Sustainable Construction, Disaster Risk Reduction (DRR), Climate Change Adaptation (CCA), Technical, Vocational Education and Training (TVET), Resilient Infrastructure, Capacity-Building

Introduction

The construction sector plays a pivotal role in shaping resilient and sustainable communities, particularly in disaster-prone and climate-sensitive regions. However, rapid urbanization, climate change, and increased disaster risks necessitate a shift towards sustainable construction practices that integrate disaster risk reduction (DRR) and climate change adaptation (CCA) strategies. To achieve this, human resource development (HRD) is essential for equipping professionals, engineers, and local communities with the necessary skills and knowledge to build resilient infrastructure that can withstand environmental challenges (ILO, 2020) (UNDRR, 2019).

A well-trained workforce ensures the effective implementation of sustainable construction techniques, disaster-resilient designs, and climate adaptation measures. The International Labour Organization (ILO, 2020) emphasizes that skill development in the construction sector not only enhances economic resilience but also plays a crucial role in achieving sustainable development goals (SDGs). Similarly, the Intergovernmental Panel on Climate Change (IPCC, 2022) highlights that workforce training and capacity-building initiatives are critical components of climate adaptation strategies, particularly in vulnerable regions like Nepal.

In many developing countries, including Nepal, HRD in sustainable construction is still in its early stages, with limited integration of DRR and CCA concepts into formal education and vocational training programs (ADB, 2021) (World Bank, 2021). Strengthening workforce capacity through targeted training programs, policy interventions, and community-based knowledge-sharing mechanisms is essential to bridge this gap. The Asian Development Bank (ADB, 2021) underscores that green and resilient infrastructure requires a skilled labor force that can adopt innovative and adaptive solutions, minimizing environmental impact while enhancing long-term resilience.

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This article explores the significance of HRD in sustainable construction, with a focus on its role in disaster risk reduction and climate change adaptation. It highlights key strategies such as technical training, competency-based education, and policy-driven capacity-building initiatives that can empower construction professionals to integrate sustainability, resilience, and adaptation into their practices. By investing in human capital, Nepal and other mountainous regions can develop sustainable and disaster-resilient infrastructure, ensuring long-term economic and environmental security (UNESCO, 2017).

Policy and Institutional Framework for HRD in Nepal

Human Resource Development (HRD) in Nepal is guided by various policies and institutional mechanisms that aim to strengthen workforce capacity, particularly in sustainable construction, disaster risk reduction (DRR), and climate change adaptation (CCA). Given Nepal's exposure to earthquakes, floods, landslides, and climate-induced disasters, HRD has been prioritized in national policies to ensure skilled human capital for resilient development.

The National Education Policy (2019) and the Technical and Vocational Education and Training (TVET) Policy (2012) emphasize skill-based education to meet the demands of sustainable infrastructure development and disaster resilience (MoEST, 2019). Additionally, the Disaster Risk Reduction and Management Act (2017) and the National Climate Change Policy (2019) integrate HRD strategies to enhance disaster preparedness and climate resilience at all levels (GoN, 2017) (MoFE, 2019).

Several institutions play key roles in HRD, including:

- Council for Technical Education and Vocational Training (CTEVT) – Oversees vocational training programs and skill development for disaster-resilient construction (CTEVT, 2023).
- National Reconstruction Authority (NRA) – Led post-earthquake reconstruction training, building a workforce skilled in retrofitting and seismic-resistant construction (NRA, 2017).
- National Disaster Risk Reduction and Management Authority (NDRRMA) – Focuses on capacity-building for emergency response, risk assessment, and community-based disaster preparedness (NDRRMA, 2021).

Despite these efforts, gaps remain in policy implementation, funding, and institutional coordination, limiting the effectiveness of HRD initiatives. Strengthening public-private partnerships, decentralizing training programs, and integrating digital learning technologies can enhance HRD in Nepal, ensuring a resilient and adaptive workforce for the future.

Skill Development for Sustainable Construction

Skill development is a critical component of sustainable construction, ensuring that Nepal's infrastructure is resilient, environmentally friendly, and resource-efficient. Given Nepal's earthquake-prone geography, rapid urbanization, and increasing climate risks, the need for a skilled workforce in green building practices, disaster-resistant construction, and climate adaptation techniques has become more pressing (ADB, 2021).

The Council for Technical Education and Vocational Training (CTEVT) plays a key role in skill development, offering training in earthquake-resistant construction, retrofitting, and the

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use of sustainable materials (CTEVT, 2023). Additionally, the National Reconstruction Authority (NRA) has trained thousands of masons, engineers, and construction workers in seismic safety standards and resilient building practices following the 2015 earthquake (NRA, 2017).

Sustainable construction training focuses on:

- Use of Eco-Friendly Materials – Bamboo, compressed stabilized earth blocks (CSEB), and locally sourced materials to reduce environmental impact (MoUD, 2020).
- Seismic-Resistant Techniques – Training on reinforced masonry, proper foundation techniques, and retrofitting of vulnerable structures (NBC, 2020).
- Energy-Efficient and Climate-Resilient Designs – Incorporating passive solar heating, rainwater harvesting, and green roofing in construction projects (MoFE, 2019).

Despite progress, gaps in accessibility to skill training, limited funding, and weak policy enforcement remain challenges. Expanding TVET programs, public-private partnerships, and digital learning platforms can strengthen Nepal's capacity to achieve sustainable and disaster-resilient construction practices.

HRD Strategies for Disaster Risk Reduction (DRR)

Human Resource Development (HRD) plays a vital role in strengthening disaster resilience by equipping individuals, institutions, and communities with the necessary skills and knowledge for disaster preparedness, response, and recovery. In Nepal, where earthquakes, floods, landslides, and climate-induced disasters frequently occur, HRD strategies for Disaster Risk Reduction (DRR) focus on capacity-building, institutional strengthening, education, and community-based training (MoHA, 2019).

1. Capacity-Building for DRR

- HRD initiatives aim to build the technical and managerial capacity of government agencies, civil society organizations, and the private sector to enhance disaster preparedness and response. Key strategies include:
- Training for Emergency Responders: The National Disaster Risk Reduction and Management Authority (NDRRMA) provides specialized training for search and rescue teams, first responders, and community volunteers (NDRRMA, 2021).
- Technical Skill Development: Training programs for engineers, masons, and construction workers on seismic-resistant construction, retrofitting, and bioengineering techniques to mitigate disaster risks (NRA, 2017).
- Integration of DRR in TVET Programs: The Council for Technical Education and Vocational Training (CTEVT) incorporates disaster risk management in vocational training curricula for various technical fields (CTEVT, 2023).

2. Institutional Strengthening for DRR

- Strengthening institutions responsible for disaster risk reduction ensures effective governance and policy implementation. Major strategies include:
- Decentralized DRR Training Centers: Establishing regional training centers for disaster preparedness and response education to reach vulnerable communities (MoHA, 2019).

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- Public-Private Partnerships (PPP): Encouraging collaboration between government agencies, NGOs, universities, and the private sector to enhance DRR-related capacity-building initiatives (UNDP, 2020).
- Policy Integration and Multi-Sectoral Coordination: Strengthening coordination among ministries, local governments, and international organizations for better HRD planning in DRR (GoN, 2017).

3. DRR Education and Awareness Programs
   - HRD for DRR also emphasizes integrating disaster risk management into education systems and public awareness campaigns. Strategies include:
   - Incorporating DRR in School Curricula: The Ministry of Education, Science, and Technology (MoEST) has introduced disaster awareness courses in school and university curricula (MoEST, 2019).
   - Community-Based Disaster Preparedness: Training local communities, schoolteachers, and youth volunteers in early warning systems, evacuation planning, and emergency response (IFRC, 2021).
   - Mass Media and ICT-Based DRR Training: Using radio, television, mobile applications, and social media to disseminate DRR knowledge and alerts (ADPC, 2020).
4. Challenges and the Way Forward
   - Despite progress in HRD for DRR, challenges such as limited financial resources, lack of skilled trainers, and inadequate local-level implementation persist. Strengthening localized training, integrating digital learning platforms, and fostering international partnerships can further enhance Nepal's disaster resilience.

Human Resource Development in Climate Change Adaptation (CCA)

Human Resource Development (HRD) is essential for strengthening Nepal's capacity to adapt to climate change by equipping individuals and institutions with technical skills, policy knowledge, and community-based adaptation strategies. Nepal's HRD efforts in Climate Change Adaptation (CCA) focus on capacity-building, institutional strengthening, and education & awareness.

1. Capacity-Building for CCA
   - Training climate scientists, engineers, and local planners in climate-resilient agriculture, water management, and green infrastructure (MoFE, 2019).
   - Strengthening Technical and Vocational Education and Training (TVET) for sustainable resource management (CTEVT, 2023).
   - Enhancing local adaptive capacity through community-based training on disaster preparedness, ecosystem conservation, and resilient livelihoods (UNDP, 2021).
2. Institutional Strengthening for CCA
   - Establishing climate research and adaptation training centers (MoFE, 2019).
   - Mainstreaming climate adaptation into national and local development plans (GoN, 2021).

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- Encouraging Public-Private Partnerships (PPP) to support HRD initiatives in climate resilience (ADB, 2020).

3. Education & Awareness
    - Integrating climate adaptation into school and university curricula (MoEST, 2019).
    - Conducting community awareness programs on climate risks and adaptation measures (IFRC, 2022).
    - Using ICT and mass media to disseminate climate adaptation knowledge (WWF, 2021).

HRD for CCA in Nepal is progressing but needs stronger policy enforcement, enhanced funding, and broader community engagement for greater impact.

Challenges in HRD for Sustainable Construction, DRR, and CCA

Despite progress, Nepal faces several challenges in developing human resources for sustainable construction, disaster resilience, and climate adaptation:

1. Limited Technical Skills and Workforce Shortages
    - Nepal lacks a sufficient number of skilled professionals in green construction, resilient infrastructure, and climate-smart planning (ADB, 2021).
    - Training opportunities are concentrated in urban areas, leaving rural communities with limited access to capacity-building programs (CTEVT, 2023).
2. Inadequate Policy Implementation and Institutional Gaps
    - While Nepal has progressive policies (e.g., National Climate Change Policy 2019, National Building Code 2020), their implementation remains weak due to limited coordination among agencies ((GoN, 2021).
    - Insufficient funding and lack of institutional mechanisms hinder effective HRD initiatives (MoUD, 2020).
3. Limited Integration of HRD into Education and Vocational Training
    - Technical and Vocational Education and Training (TVET) programs do not fully incorporate DRR and climate resilience in their curricula (MoEST, 2019).
    - Higher education institutions have insufficient research and innovation in sustainable infrastructure development (UNDP, 2021).
4. Low Public Awareness and Community Engagement
    - Many communities lack awareness and training on disaster preparedness, resilient construction, and climate adaptation (IFRC, 2022).
    - Marginalized groups, including women and indigenous communities, have fewer opportunities for skill development in sustainable construction and DRR (WWF, 2021).

Conclusions and Recommendations

Conclusions

Human Resource Development (HRD) is a key driver for promoting sustainable construction, disaster risk reduction (DRR), and climate change adaptation (CCA) in Nepal. Over the years,

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Nepal has introduced policies and training programs to enhance HRD in these sectors, such as the National Building Code (NBC), Technical and Vocational Education and Training (TVET) programs, and the National Adaptation Plan (NAP). Despite these efforts, several challenges remain, including limited access to technical training, lack of integration of DRR and CCA in education, weak institutional coordination, and insufficient funding.

Given Nepal's geographical vulnerability to earthquakes, landslides, and climate-induced disasters, HRD must be strengthened at all levels—from community-based training to specialized education for engineers, architects, and policymakers. Addressing HRD challenges will ensure resilient infrastructure, disaster preparedness, and effective climate adaptation strategies that support Nepal's long-term sustainable development goals (SDGs).

Recommendations

1. Enhancing Technical and Vocational Training (TVET) for Disaster-Resilient and Green Infrastructure
    - Expand TVET programs to include earthquake-resistant construction, sustainable building materials, and green energy solutions (CTEVT, 2023).
    - Develop region-specific training for construction workers, engineers, and planners to promote local adaptation techniques, such as bioengineering for landslide prevention and eco-friendly infrastructure.
    - Strengthen training partnerships with municipalities and the private sector to improve employment opportunities for trained personnel in sustainable construction and DRR.
2. Strengthening Institutional Coordination and Policy Implementation
    - Enhance coordination among the Ministry of Home Affairs (MoHA), Ministry of Federal Affairs and General Administration (MoFAGA), National Disaster Risk Reduction and Management Authority (NDRRMA), and local governments for effective HRD implementation.
    - Increase budget allocation for DRR and CCA skill development programs, ensuring access to HRD initiatives in rural and hazard-prone areas (GoN, 2021).
    - Improve enforcement of the National Building Code (NBC, 2020) by mandating HRD training for engineers, masons, and urban planners before construction projects are approved.
3. Integrating DRR and CCA into Education and Research
    - Introduce disaster-resilient infrastructure and climate adaptation courses in engineering, architecture, and environmental science programs in Nepali universities.
    - Support research and innovation in climate-resilient construction materials, nature-based solutions for disaster risk management, and smart technologies for early warning systems.
    - Encourage academic partnerships with international institutions to improve HRD research capacity and knowledge exchange.

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4. Expanding Community-Based Capacity-Building and Awareness Programs
    - Conduct localized HRD training for community leaders, local masons, and women's groups to strengthen their role in disaster preparedness and climate adaptation (IFRC, 2022).
    - Scale up eco-friendly and traditional knowledge-based construction techniques, such as Rammed Earth, Bamboo, and Stone Masonry, which are climate-resilient and cost-effective.
    - Utilize radio, mobile apps, and local networks to spread HRD-related information on disaster preparedness, safe construction, and climate resilience to remote communities.
5. Investing in Digital Technology for HRD
    - Develop e-learning platforms and mobile applications for remote access to DRR and CCA training, particularly targeting rural communities and technical professionals.
    - Promote the use of GIS, drone technology, and artificial intelligence (AI) for disaster risk mapping and climate adaptation planning in HRD programs.
    - Strengthen Nepal's early warning systems by training HR professionals in data analytics, geospatial technology, and risk communication.
6. Ensuring Inclusive HRD for Vulnerable Communities
    - Establish specialized HRD programs for women, marginalized communities, and indigenous groups to improve their employment and leadership roles in sustainable construction, DRR, and CCA.
    - Provide scholarships and financial incentives to encourage women and youth to pursue careers in sustainable infrastructure and disaster management.
    - Support skills-based entrepreneurship programs that empower local masons, engineers, and community leaders to lead sustainable development initiatives.

By prioritizing HRD in sustainable construction, DRR, and CCA, Nepal can develop a resilient workforce, enhance disaster preparedness, and promote climate-adaptive infrastructure, ensuring a safer and more sustainable future for all.

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