Asta-Ja Education and Training for Ecological and Environmental Sustainability and Sustainable Economic Development in Nepal Part I

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Abstract

Through the concerted effort of the royal family and the government of Nepal with international aid agencies, foreign governments, donor organizations, NGOs, and the private sector over the past several decades, Nepal has achieved remarkable success in its educational sector, currently with 17 universities, 5 autonomous institutions, more than 1,400 colleges, and 34,368 schools nationwide. Despite these remarkable developments in the educational sector in the past several decades, Nepal's education and training are still subpar, uncoordinated, fragmented, largely theoretical, lacking access and inclusion, deficient in physical facilities and trained teachers, and the lack of appropriate curriculum and educational and training frameworks. Many institutions of higher education and schools in the country are experiencing seriously low enrollment and high dropout rates. Over 100,000 students leave the country for higher education abroad annually and about 3,000 youths leave the country daily for foreign employment. Almost a quarter

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of Nepal's total population lives below the poverty line, 23% of the total population cannot read and write, and there is a very high unemployment rate. Foreign trade is declining with skyrocketing trade deficits. The trade deficit for 2022/2023 FY was over USD 11 billion. With the US$1,456 PCI GDP, Nepal still belongs to the category of least developed countries. To effectively address these challenges, Nepal's education and training system needs to be more practical, research-focused, innovative, community-oriented, and directly aligned with sustainable economic development and ecological and environmental sustainability. The Asta-Ja (Asta-Ja meaning eight *Ja* in Nepali letter, *Jal* (water), *Jamin* (land), *Jungle* (forest), *Jadibuti* (medicinal and aromatic plants), *Janshakti* (manpower), *Janawar* (animal), *Jarajuri* (crop plants) and *Jalabayu* (climate)) Framework effectively guides the policymakers, academicians, educationists, developmental organizations, and governmental agencies in developing effective curricula, training teachers, producing skilled manpower, conducting practical training, and aligning teaching and learning for the nation's natural and cultural resources. It will help transform Nepal's education and training into a more effective, problem-solving, and innovative system to enhance ecological and environmental sustainability and sustainable economic development.

Keywords: The Asta-Ja Framework, Nepal education era, higher education, practical curriculum, security challenges.

1 Introduction

With the advent of the concept of sustainable development from the Brundtland Commission (WCED, 1987) and widespread global concerns for ecological and environmental sustainability, climate change adaptation and resiliency, and ecological living, aligning the nation's educational system with ecological and environmental sustainability and sustainable development has become urgent. An interdisciplinary and practical approach to education is necessary for sustainable development (Annan-Diab and Molinari, 2017). Practical education is critical for addressing complex agricultural and environmental challenges (Poudel et al., 2005). The United Nation's Decade for Education for Sustainable Development (2005–2014) focused on several cross-cutting themes such as poverty alleviation, gender equality, environmental protection, cultural diversity, peace and harmony, rural development, and urbanization, and suggested embedding the principles and practices of sustainable development in all educational systems (Kopnina and

Meijers, 2012; UNESCO, 2014). Inclusive and equitable quality education for lifelong learning for all is one of the 17 Sustainable Development Goals (SDGs) of the United Nations, which aims that the learners acquire all necessary skills and knowledge for promoting sustainable development by 2030 (UN, 2015).

Nepal made remarkable progress in educational development over the past seven decades (Thapa, 2003; Mathema, 2007; World Bank, 2023), but there are still many educational challenges that need to be addressed immediately. These challenges include quality differences by geography, household characteristics, and by private versus public schools (World Bank, 2023), gender and ethnic inequity, low enrollment, high dropout rates, and unavailability of educational materials. After the promulgation of the 2015 Constitution and the formation of a three-tiered government system, Nepal adopted a new educational classification system which includes basic (1–8th grade), lower secondary (9–10th grade), and higher secondary (11–12th grade) in 2016 AD. Then 10th grade SLC (School Leaving Certificate) was replaced by SEE (Secondary Education Examination). The percentage system is converted to letter grades. Higher education changed from an annual system to a semester system. These changes have brought many new challenges in Nepalese education including administration, curriculum design, academic infrastructures and facilities, instructional materials, teacher training, and policy coordination. A large part of the teaching and learning materials includes books and other materials developed outside the country and translated into Nepali language. In higher education, political power-sharing in appointments, not completing the semesters on time, and delays in final exams have become major problems. Politicization of administration and infighting in the schools have negatively impacted Nepalese education.

The widening gap between private vs public school education is a major concern in Nepal. There is a huge difference in student pass-out rates between private and public schools (Mathema, 2007). Private schools, which are accessible to higher-income groups, outperform public schools in students' pass-out rates primarily due to their better teaching and learning environments, timely supply of educational materials, and the presence of better school facilities and infrastructure. Private schools restrict teachers from participating openly in party politics, finishing the curriculum in a timely fashion, and maintaining an appropriate teaching and learning environment in the school. Private schools recruit better-qualified teachers, and they use English as a medium of instruction. After high school, most students from private schools join colleges in the country and eventually end up going to

foreign countries for higher education, while a large proportion of students graduating from public schools end up going to foreign labor markets due to the lack of employment opportunities in Nepal. Reportedly, about 3,000 youths leave the country daily for foreign employment (Jha, 2024) and over 100,000 students annually leave the country to go abroad for higher education (Bhattarai, 2024).

Massive outmigration of youths for employment and education abroad has far-reaching consequences for Nepal's developmental activities, natural resource utilization, research and innovation, societal development, economy, and national sovereignty. Rural Nepal is becoming empty and farmlands are being abandoned due to the outmigration of the youth. There is a widespread concern and nervousness among the students that Nepalese government is failing to accelerate economic development and generate employment opportunities in the country. Students are less and less motivated in education and learning. There is an urgent need for the development of a nation-focused educational system that imparts basic knowledge on country's natural resources, geography, history, tradition, culture, and sociology; enhances practical knowledge for sustainable conservation and development of natural resources, helps generate employment, and supports accelerated sustainable economic development in Nepal.

Poudel (2008) published a pioneering framework of Asta-Ja meaning eight *Ja* in Nepali letter, *Jal* (water), *Jamin* (land), *Jungle* (forest), *Jadibuti* (medicinal and aromatic plants), *Janshakti* (manpower), *Janawar* (animal), *Jarajuri* (crop plants) and *Jalabayu* (climate) and suggested self-reliant accelerated economic development in Nepal through sustainable conservation, development and utilization of Asta-Ja resources. There is an urgency to develop a workforce capable of harnessing Asta-Ja resources, generating employment, and accelerating the economic growth of the country (Poudel et al., 2023). This workforce should have strong motivation, knowledge, skills, good attitudes, and commitment to sustainable economic development of the country. Educational curricula should be developed based on the Asta-Ja resources for practical education, economic growth, employment opportunities, and ecological and environmental sustainability. The subsequent sections discuss the historical perspective on Nepal's educational development and elucidate the Asta-Ja Framework as an all-encompassing approach to practical, holistic, and comprehensive education and training for developing a skilled workforce to enhance ecological and environmental sustainability and sustainable economic development in Nepal.

2 Historical Perspective

2.1 Ancient Education

Ancient education in Nepal was mainly under the Vedic and Buddhist systems. Vedic education included primarily the *Gurukul* system, in which students lived with the teachers in *ashrams* and learned about life, administration, warfare, religious scriptures, yoga and meditation, moral education (Timilsina, 2016), and homeopathy practices. This system laid the foundation for education in Nepal. Teaching and learning were through the Sanskrit language and by chanting hymns and *mantras*. Buddhist education system included reading Buddhist scriptures and other skill-building activities such as weaving and medicine. The meditation, disciplines, and wisdom constituted the core of Buddhist teaching and learning (Kumari and Rani, 2019). Monasteries or *Viharas* served as the learning centers. Buddhist education and learning were not limited to any caste or section of the society. While the Vedas and the Upanishads constituted the main texts in the Vedic system, the Tripitaka constituted the main texts in the Buddhist system. Buddhist scriptures were written in Pali, Sanskrit, and other languages.

2.2 Modern Nepal and Formal Education

Modern Nepal came into existence after the Great King Prithvi Narayan Shah (1723–1775 AD) from Gorkha unified small states known as "*baise chaubise rajyas*" in the Gandaki and Karnali regions, three Malla kingdoms in Kathmandu Valley, three Sen states in the south-eastern Terai, and the kingdom of Mustang. He declared the creation of modern Nepal on September 25, 1768 AD, and moved the capital from Gorkha to Kathmandu.

Modern Nepal's formal education can be divided into three eras, (1) the Pre-Democracy era (before 1951 AD), (2) the Democratic Governance Era (1951–2008 AD), and (3) the Federal Democratic-Republican era (2008 AD onward). During the Pre-Democracy era, the nation was governed by an autocratic Rana Rule for 104 years, which ended on February 18, 1951 AD when King Tribhuvan Bir Bikram Shah declared democracy in Nepal. The oldest educational institution established in Nepal is reportedly Yjnayavalkya Lakshminarayan Vidyapeeth for Sanskrit and Vedic education in 1774 AD in the Mahottari district of Nepal. The establishment of Durbar High School in 1854 AD by then Prime Minister Jung Bahadur Rana, initially to teach the sons of the Rana family and opened to the public in 1920 AD, is the first institution established for imparting formal English education to students in

Nepal. Tri-Chandra College, established in 1918 AD., is Nepal's first institution of higher education. Additional notable educational activities during this era include the establishment of the Ayurved College in 1930 AD, setting up the S.L.C. Board in 1932 AD, the founding of a Technical Training School to produce overseers in 1942 AD, and the establishment of the Montessori School in Kathmandu in 1950 AD (Aditya, 2003). Public education was limited during the Pre-democracy era. Nepal's literacy rate was just 2% when Nepal embarked upon democracy in 1951 AD.

The Democratic Governance era (more precisely, February 18, 1951 – May 28, 2008 AD), which began after the establishment of democracy in 1951 AD, characterizes with a nationwide heavy focus on the development of formal education in the country. Nepal started developing its five-year national development plan in 1956 AD, which provided programs and budgets for developing academic institutions in the nation. The establishment of the Tribhuvan University on June 25, 1959 AD marks a major milestone in the educational history of Nepal. The royal family announced the establishment of the Tribhuvan University in the name of King Tribhuvan on the day of his first death anniversary. King Tribhuvan died on 9 March 1955 AD. His two queens, Queen Kanti Rajya Lakshmi Devi Shah and Queen Ishwari Rajya Lakshmi Devi Shah, served on the university's commission established on March 31, 1956 AD as the chairperson and the vice-chairperson, respectively. They laid the foundation stone on June 25, 1958 AD by donating 18.75 hectares of land. Tribhuvan University being the oldest and largest institution of higher education in Nepal has a significant impact on the lives of Nepali citizens. Tribhuvan University has 62 constituent campuses, 38 Central Departments, 5 technical institutes to administer science and technology courses, and 1084 affiliated private and public colleges. Tribhuvan University has four research centers, (1) Center for Economic Development and Administration (CEDA), (2) Center for Nepal and Asian Studies (CNAS), (3) Research Center for Applied Science and Technology (RECAST), and (4) Research Center for Educational Innovation and Development (CERID). Tribhuvan University ranked first in terms of number of full-time students worldwide 2023/2024 with 482,541 students (Statista, 2024). While it was only Tribhuvan University until 1985 AD, five additional national universities with 37 constituent campuses and three institutes/academies of health sciences were established during this Era.

The development of school education (elementary, middle, and high school education) was also a remarkably high priority of the government in the Democratic Governance era. The government of Nepal introduced

compulsory education to 1–8th grade in the late 1960s and extended to the secondary (9–10th grade) in 1980s. In 1971 AD, the government of Nepal enacted Education Act 1971 that required students to take at least one vocational subject beginning in their eighth grade and until their tenth grade. Developing excellent workforce through quality education and better management of the school system was the focus of the Education Act 1971. The Preamble of the Education Act reads:

> "*Whereas, in order to prepare manpower for national development and to maintain good conduct, decency and morality of the people in general in consonance with multi-party democratic system, it is expedient to promote quality education through improvements in the management of existing and future schools throughout the Kingdom of Nepal*."

The educational development during the Democratic Governance era was a remarkable success. The literacy rate of Nepal in 2008 AD, the end of the Democratic Governance era, was about 55.6%.

The Federal Democratic-Republican era that started on May 28, 2008 AD after the parliament of Nepal voted against the king and declared a republican state, has added six additional universities with 46 constituent campuses, five provincial universities, and 5 autonomous institutes/academies of health sciences in the country. This era brought a major change in the educational system in higher education changing from the annual system to semester systems and from percentage grade to letter grades. The promulgation of the 2015 Constitution federalized the nation at the federal, provincial, and local levels of governance. With the federalization of the country, the educational system was also federalized giving authority to local government to manage up to 8th grade (basic education), provincial government to manage 9-12th grade (secondary education), and federal government to manage higher education (colleges and universities). Similarly, high school education also got major changes replacing SLC with SEE and percentage grades by letter grades. Emphasis is given to imparting practical education among the students at all levels. The Federal Democratic-Republican era is characterized by the remarkable growth of private schools especially after the enactment of the Education Act 2019. There are currently 6,500 private schools in the country. Nepal's literacy rate has reached 77.4% (NSO, 2024).

Nepal's educational development is heavily supported by international organizations, bilateral aid agencies, and other programs including the World Bank, UNICEF, USAID, UNESCO, ADB, EU, JICA, ActionAid, and World

Education. Countries like India, Norway, and Finland also support Nepal's educational development. Several NGOs and Foundations also support education in Nepal. Nepal's educational developmental activities are guided by UNESCO's "rights to education " framework focusing on free and compulsory primary education, non-discrimination, adequate infrastructures, quality trained teachers, safe and non-violent environment, relevant education, participatory decision making, transparent and accountable schools, and quality learnings (ActionAid International Nepal, 2023; UNESCO, 2024). USAID has been supporting the Government of Nepal in educational development for the past 75 years in several areas including educational policy reforms, teacher training, inclusive education, assessment, development of teaching and learning materials, school libraries, and capacity-building (USAID, 2024). World Bank has been supporting Nepal's basic and secondary education for quality education, equitable access, and efficiency (World Bank, 2023).

3 The Asta-Ja Framework

3.1 The Theory and Principles of Asta-Ja

The Asta-Ja Framework elucidates the fact that the eight elements of the Asta-Ja system, *Jal* (water), *Jamin* (land), *Jungle* (forest), *Jadibuti* (medicinal and aromatic plants), *Janashakti* (human resources), *Janawar* (animals), *Jarajuri* (crop plants), and *Jalabayu* (climate) are intricately linked by having strong interrelationships and linkages between and among themselves (Figure 1). In the Asta-Ja system, the *Jalabayu* (climate) is the central pivotal and the most critical element, which drives all other seven elements of Asta-Ja. Similarly, *Janashakti* (human resource) keeps the potential for changing climatic conditions or preserving and destroying the rest of the Asta-Ja elements. As the eight elements of the Asta-Ja system are strongly linked, any changes in one element affect another and the full consideration of all eight elements must be given while utilizing Asta-Ja resources for sustainable economic development. For example, to enhance the sustainability and profitability of agriculture, it is critical to conserve and develop natural resources such as land, forests, animals, and water and utilize climatic conditions appropriately. The Asta-Ja system represents the four sub-systems of the planet Earth, the hydrosphere (*jal*), lithosphere (*jamin*), atmosphere (*jalabayu*), and biosphere (*jungle, jadibuti, janshakti, janawar*, and *jarajuri*). Therefore, conservation, development, and the sustainable utilization of Asta-Ja resources enhance the ecological and environmental sustainability of the planet Earth.

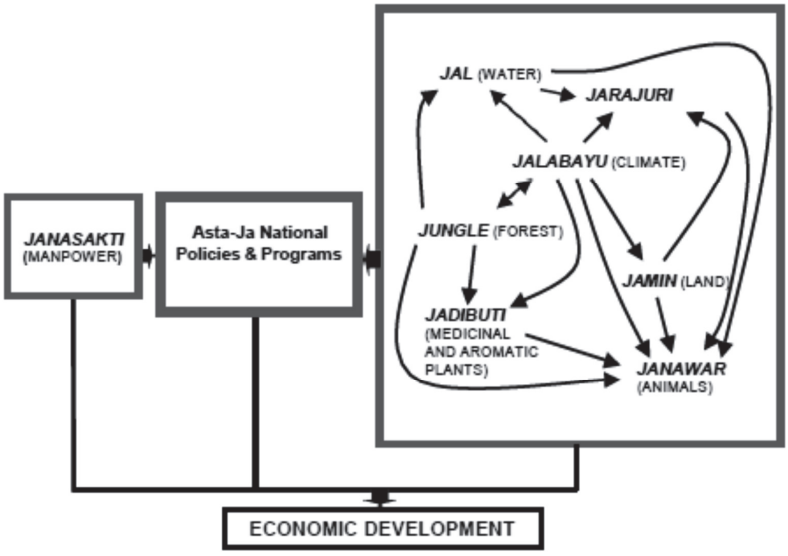

Figure 1 Interrelationships and linkages among Asta-Ja, and the formulation of national policies and programs for economic transformation (adopted from Poudel, D.D. 2008. Management of Eight "Ja" for Economic Development of Nepal, *Journal of Comparative International Management*, 11(1): 15–27; page no. 23, Figure 2).

The eight principles of the Asta-Ja Framework include (1) Community awareness, (2) Capacity-building, (3) Policy decision-making, (4) Comprehensive assessment, (5) Interrelationships and linkages, (6) Sustainable technology and practices, (7) Institutions, trade, and governance, and (8) Sustainable socio-economic transformation and community development (Poudel, 2016a). While the principle of community awareness constitutes the central pivotal principle, the principle of sustainable socio-economic transformation and community development serves as an overarching principle with tangible and visible outputs of Asta-Ja implementation. These principles provide practical guidelines for the design and implementation of Asta-Ja policies and programs for the conservation, development, and utilization of Asta-Ja resources for sustainable economic development. As the Asta-Ja system constitutes the nation's most valuable resources, grassroots-based, practical, and scientifically proven Asta-Ja national policies and programs are necessary for the sustainable utilization of Asta-Ja resources and accelerated economic growth.

The Asta-Ja Framework serves as a sound unified planning and management tool for natural resources and human resource development (Poudel,

2016a). The Asta-Ja Framework connects different disciplines, stakeholders, businesses, consumers, governmental agencies, and policy-making bodies and links them together. Asta-Ja collects and utilizes experience, skills, and wisdom in resource conservation, development, and utilization from experienced individuals while it emphasizes skills and knowledge development and capacity-building of younger generations.

3.2 Asta-Ja Assessment

A comprehensive assessment of Asta-Ja resources and the development of an Asta-Ja National Resource Inventory (Asta-JaNRI) is necessary for sustainable economic development based on natural and human resources in Nepal. The Asta-JaNRI should contain comprehensive information about the status of the Asta-Ja resources and be updated periodically through Asta-JaNRI surveys. Poudel (2011) has discussed the need for a comprehensive assessment of Asta-Ja, Asta-Ja database, and economic analyses. The Asta-JaNRI database for *Jal* (water) can include volume, discharge, flood, glaciers, water quality, reservoir capacity, seasonal variability, irrigation, drinking water supply, and any other pertinent information about water sources. Similarly, the *Jamin* (land) database can include information on land use types, soil quality, minerals and mines reserves, tourism potential, land holding size, rangelands, wetlands, land tenure, land fragmentation, land degradation, and land rehabilitation. The *Jungle* (forest) database may contain information on forest distribution, types, productivity, biomass, growth, regeneration, industrialization, forest fire, and sustainable harvesting. The *Jadibuti* (medicinal and aromatic plants) database could contain information on *Jadibuti* types and their distribution, ecology, production, sustainable harvest, possible domestication, market potential, and medicinal and other uses. The *Janashakti* (human resource) database could include information on the total workforce, skilled workforce, workforce distribution, and workforce availability. The *Janawar* (animals) database could include information on domestic and wild animals. Variables for the database could be the number and distribution of animals, food and nutrition, production, production potentials, genetic improvement, production management, commercial values, market opportunities, diseases, parasites, adaptability, and habitat conservation. The *Jarajuri* (crop plants) database can be a very extensive database on agricultural crop production. This database could contain information on crops, commercial crop production zones, crop productivity, genetic improvement, crop physiology, adaptability, cropping systems, agronomic practices, diseases and

pests, and commercial values. The *Jalabayu* (climate) database may include information on climatic zones, precipitation, temperature, humidity, wind speed, solar radiation, monsoon, cloud cover, winter chills, droughts, and other weather-related variables. Various techniques and tools such as surveys, census data, remote sensing (RS), global positioning system (GPS), geographic information system (GIS), statistical models, mathematical equations, geostatistics, and computer models should be utilized in establishing and regularly updating the Asta-JaNRI. There is already a large amount of data related to Asta-Ja elements and natural disasters such as landslides, flooding, earthquakes, Glacial Lake Outburst Flood (GLOF), forest fires, or drought, which is scattered all around with governmental agencies, research institutions, and other organizations (Poudel, 2011). Collating, synthesizing, and developing a common data portal for these datasets will be a good starting point in building the Asta-JaNRI. The comprehensive assessment of Asta-Ja resources helps the government and local communities in developing a holistic view of available natural resources, understanding the challenges and opportunities for sustainable resource utilizations, industrialization, tourism development, investment management, income generation, enhanced ecological and environmental sustainability, and sustainable economic development. The Asta-JaNRI will be immensely helpful in appropriate policy decision-making about sustainable conservation, development, and utilization of Asta-Ja resources.

To capture the current status of Asta-Ja resources at the grassroots community level, Poudel (2018a) developed the Asta-Ja Log Frame. The Asta-Ja Log Frame is an eight-by-eight matrix of the Asta-Ja resources and the eight principles of the Asta-Ja Framework as discussed above. Table 1 below shows a hypothetical Asta-Ja Log Frame for Kathmandu Metropolitan City, Nepal. When properly utilized, the Asta-Ja Log Frame captures emerging issues and concerns related to natural resources in the locality. It also helps identify opportunities for the best utilization of Asta-Ja resources. It serves as an instrument for resource planning and management and educates local communities and stakeholders. The use of the Asta-Ja Log Frame enhances the local knowledge of natural and human resources among community organizations, local governmental agencies, academic institutions, community members, and other stakeholders. It is important to have a thorough knowledge of Asta-Ja resources on the part of individuals who lead the Asta-Ja Log Frame filling team. It is necessary to have active participation from various professional and community members including teachers, bankers, government representatives, community members, health

Table 1 A hypothetical example of Asta-Ja log frame for the city of Kathmandu, Nepal (adopted from Poudel, D.D. 2018a. Restructuring National Planning Commission Focusing on Asta-Ja and Nepal Vision 2040, Asian Profile, 46(2): 151–167; page no. 164, Table 1)

	Community Awareness	Capacity-building	Policy Decision Making	Interrelation-ships and Linkages	Comprehensive Assessment	Sustainable Technologies and Practices	Institutions, Governance, and Trade	Sustainable Community Development and Socio-economic Transformation
***Jal* (Water)**	Drinking water, drainage, flooding	Water conservation, test labs	Drinking water projects, flood control	Ground water depletion and Subsidence, community resiliency	Ground water, surface water, hydrology	Water saving technologies, waste water recycling, drainage	Municipal Water Supply, Bottle Water Companies	Clean rivers, groundwater recharge, flood control
***Jamin* (Land)**	Land-use, dust	Land-use, land protection	Open space, dust control	Congested living and public health	Land degradation	Green belt, lawn and grass cover	Soil Conservation Office, Land Office	Climate smart communities, recreational areas
***Jungle* (Forest)**	Urban trees, sacred grooves	Tree nurseries, parks, community forestry	Green city, sacred grooves	Forest and water resources	Forest species and wildlife	Urban tree management, soil erosion control	Municipality Office, Soil Conservation Office	Green environment, tourism development
***Jadibuti* (Medici-nal and aromatic plants)**	Ayurvedhic medicine, herbs	Memory bank, remnants	Domesticating herbs, processing industries	Medicinal and aromatic plants and riparian buffers	Inventory of medicinal and aromatic plants	Medicinal and aromatic plant nurseries, chemical extraction	Department of Medicinal and Aromatic Plants, District Agricultural Office	Community gardens, tourism, Plant ID tours

(*Continued*)

Table 1 Continued

	Community Awareness	Capacity-building	Policy Decision Making	Interrelation-ships and Linkages	Comprehensive Assessment	Sustainable Technologies and Practices	Institutions, Governance, and Trade	Sustainable Community Development and Socio-economic Transformation
***Janshakti* (Man-power)**	Education, capacity-building, employment	Schools, training centers	Public education, private schools	Education and employment	Education and ethnicity	Teaching practices, online education	Department of Education, Municipal Government	Practical education, employment
***Janawar* (Animals)**	Dairy, pets, chicken	Market, veterinary services	Commercial production, collection centers	Climate change and livestock	Livestock productivity	Sustainable livestock production, organic production	Department of Agriculture, Veterinary Services	Income generation, import substitution
***Jarajuri* (Crop plants)**	Vegetable production, organic produce	Market, technical assistance, IPM	Commercial production, loans	Soil condition and crop productivity	Crop productivity	Sustainable crop production technologies, fertilizer	Department of Agriculture, Cooperatives	Income generation, employment
***Jalabayu* (Climate)**	Drought, extreme rain events	Flood control, crop diversifi-cation	Climate-smart agriculture, flood	Climate change and wildlife	Climate change impacts	Climate-smart agriculture, drought resistant varieties,	Department of Meteorology, Municipality Office	Climate resilient communities, resource conservation

workers, and other stakeholders in these discussion meetings. There should be an active participation by the local communities in these events.

A pre-prepared list of questions is necessary for Asta-Ja Log Frame discussion sessions (Poudel, 2015). New questions will emerge during the discussion. To start discussions, questions can be related to any aspects of Asta-Ja such as water, climate, medicinal and aromatic plants, livestock, wildlife, etc. It is important to make clear to the local community members that information generated from the discussion will be tabulated in the Log Frame and will be utilized later for Asta-Ja policies and program development. It is possible that the discussion will be diverted and the answers may not percolate immediately. The information generated should be noted down on a flip chart before entering into the Log Frame. Community ideas and answers should be synthesized one by one and should fill in the Asta-Ja Log Frame when appropriate information is generated. All the ideas and data generated in this process of filling the Asta-Ja Log Frame should be recorded in a separate meeting note. All the sixty-four boxes of Asta-Ja Log Frame should be accurately filled.

From the community discussion, it is important to have answers at least to the following areas:

(a) General understanding of the community about Asta-Ja resources, lack of understanding about Asta-Ja resources, and status of the Asta-Ja resources.
(b) Local knowledge available and the necessity of community capacity-building for conservation, development, and utilization of Asta-Ja resources.
(c) Policy gaps on Asta-Ja resources utilization and development including rules, regulations, and laws necessary for sustainable conservation, development, and utilization of Asta-Ja resources.
(d) The assessment and inventorying of Asta-Ja resources in the community.
(e) Understanding of the interrelationships and linkages of Asta-Ja elements in the locality.
(f) Technologies and practices being utilized at the local level for conservation, development, and utilization of Asta-Ja resources, and the need for sustainable technologies and practices.
(g) Presence of community organizations, governmental agencies, academic institutions, and other organizations at the local and regional levels that relate to Asta-Ja resources development and utilization, and trade and businesses, and the governance of Asta-Ja resources.

(h) Conservation, development, and utilization of the Asta-Ja resources for income generation and sustainable community development in the locality.

3.3 Security Challenges: Food, Water, Energy, Climate, and Environmental Security

3.3.1 Food security

The fertile lands in the Terai, the mid-hills valleys, foothills, river terraces, constructed terraces, sloping lands, and the high-altitude rangelands support diverse agricultural production systems and animal husbandry in Nepal. Declining agricultural production, increasing imports of agricultural commodities, rising abandonment of farmlands, stagnated agricultural productivity; and the lack of agro-industrialization, timely availability of agricultural inputs, irrigation facilities, agricultural produce storage facilities, and research and innovation in agriculture are some of the reasons for increasing food insecurity in Nepal. Good soil health conditions, appropriate cropping systems, irrigation facilities, timely availability of agricultural inputs, sustainable agricultural technologies and practices, appropriate agricultural support systems, and research and innovation are necessary for increased agricultural production and food security. Poudel (2019) identified five drivers to increase agricultural production and food security in Nepal. They are: (1) Smallholder mixed-farming system, (2) Incentives, (3) Pro-poor market, (4) Infrastructure, and (5) Policies and programs. Smallholder mixed-farming system (driver 1), which is highly diverse, labor intensive, and strongly linked with the eight elements of Asta-Ja (i.e., livestock, forest, water resource, medicinal and aromatic plants, human resource, climate), is the "nucleus" of agriculture in Nepal. The smallholder mixed-farming system should be developed through adaptive research and development, extension services, agricultural investment, incentives, and national priority. Agricultural produce such as organic fruits and vegetables, dairy products, medicinal and aromatic plants, condiments, and spices such as cardamom, ginger, turmeric, garlic, onion, prickly pears, and cinnamon have high export potential. Given the unique climatic conditions and topography, Nepal has a great competitive advantage for off-season vegetable production, vegetable seed production, and the production of exotic flowers and fruits. Major policy reforms necessary to agriculture include purchase and price guarantee of agricultural commodities, geographical clustering of agriculture, agro-industrialization, healthy high-value fruits and vegetables and healthy

food products, diversification of agriculture, innovation, commercialization of smallholder mixed-farming system, and the implementation of several adaptive policy measures. A focus on the production of nutritious and healthy organic foods (Poudel and Wildman, 2001) and other nutraceuticals, functional, and medical foods would help generate foreign income from agricultural exports.

3.3.2 Water security

Water security in Nepal centers on the availability of good quality water in sufficient quantity for various uses including drinking water, agricultural uses, fish and wildlife propagation, religious uses, industrial uses, environmental uses, recreational uses, hydropower, and others. Despite Nepal's vast water resources (Poudel, 2008), the water supply for drinking water, irrigation, industries, and municipalities is severely lacking in most parts of the country due to the lack of infrastructure. A comprehensive water resource inventorying, development of a nationwide water resource utilization plan, investment in water infrastructures, design of appropriate policy measures for sustainable water use, and monitoring and evaluation of water availability, quality, and quantity are necessary activities to enhance water security in Nepal (Poudel, 2021a). Climate change has severely impacted the drinking water supply in Nepal's mid-hill regions, leading to spring dry-ups and a decline in spring discharges (Poudel and Duex, 2017). Implementation of best management practices (BMPs) is necessary for sustainable water conservation, development, and utilization. Measures such as afforestation, groundwater recharge, lifting drinking water, drinking water supplies, irrigation canals, groundwater utilization, and pollution control will enhance water security in Nepal. Water quality monitoring and modeling help identify hotspots for pollutants in the watershed (Poudel et al., 2013; Poudel, 2016b). Integrated watershed management planning and implementation for soil and water conservation and environmental quality is necessary for water security.

3.3.3 Energy security

Decarbonization and electrification of energy end use is one of the major challenges for sustainable energy in Nepal. As over 72 percent of the energy used in the country comes from biomass and wastes such as fuelwood, cow dung, and crop residue, it is critical to develop a comprehensive energy plan for decarbonization of the energy end-use in Nepal (Poudel, 2021b). Energy dependence on fuelwoods that leads to deforestation and the use of cow dung and crop residue contradict the sustainable land management

goal through carbon sequestration and organic matter build-up in agricultural lands. Burning fuelwood, cow dung, and crop residues as energy sources cause serious respiratory health consequences and air pollution. Replacement of LPG will also reduce GHG emissions. Transportation is another sector that has a high potential for decarbonization and electrification of energy end-use. To acquire energy security in Nepal, Poudel (2021b) proposed a strategic energy planning (SEP) framework, which includes six steps. The first step of SEP, goal setting, begins with clear answers to the questions of where, when, how, and how much electricity development is going to happen soon and the priority rankings of the hydropower plants. The second step in SEP includes the development of hydroelectricity and alternative energy sources. As Nepal has a high potential for the generation of a large amount of hydroelectricity, it is important to identify appropriate modalities for hydropower development. Micro-hydropower ($<$100 kW) development was the major emphasis for rural electrification of the country starting in the 1960s. The third step in SEP is the energy infrastructure. Nepal's high-voltage transmission lines and electricity distribution system are relatively weak and cannot manage a large amount of electricity flow. Also, there is a huge amount of electricity loss due to inferior-quality transmission. Distribution lines are easily affected by windstorms. Overall, the reliability and quality of the electricity availability is a problem. The fourth step in SEP includes decarbonization and electrification of energy end-use. Electric vehicles, electric trains, ropeways, and vehicles running on biofuels will promote the development of renewable and clean energy resources in the country. Industrial and commercial sectors also need decarbonization and electrification of energy end-use. The fifth step in SEP includes monitoring and evaluation of the energy development and supply programs, project costs, electricity demand and prices, users' preferences, improvement in system reliability, quality of electricity, and environmental conditions. Comprehensive and timely monitoring and evaluation of the energy sector is necessary for sustainable energy supply and security. The sixth and last step in SEP includes reporting and community awareness. Community awareness and participation in the development of hydropower and other alternative energy sources is critical for energy sustainability in the country.

3.3.4 Climate security

Conspicuous climate change impacts in the form of declining drinking water sources, drought, flood, emerging diseases and parasites on livestock, agricultural loss, forest degradation, wildlife losses, ecological degradation, and

people and wildlife migration are observed in Nepal (Poudel, 2015). Unless timely addressed, climate change impacts may cause social and political conflicts in the country. Reducing climate risks to human society and building community resiliency are the main goals of climate security. Accurate assessment of climate change impacts, raising community awareness about climate change impacts, designing appropriate climate change adaptation policy measures, and implementing climate change adaptation measures are necessary for climate security in Nepal (Poudel, 2021a). Widespread climate change community awareness initiatives through various processes including formal education, training, outreach activities, media, and other means of communication are urgent. Risk mitigation and adaptation to climate change could be achieved through various activities such as Climate Smart Agriculture, green infrastructure, drought resistance varieties, water conservation, reducing water pollution, flood protection, and resiliency building. Agricultural practices such as IPM technologies, greenhouse tunnels, drip irrigation, agroforestry practices, and improved livestock sheds enhance climate change adaptation (Poudel, 2015). The government of Nepal has developed the National Adaptation Program of Action, which has identified climate adaptation needs across six cross-cutting sectors: agriculture and food security, water resources and energy, climate-induced disasters, forests and biodiversity, public health, and urban settlements and infrastructure (Poudel, 2021a). Appropriate climate change adaptation measures should be implemented in these sectors while conducting regular monitoring of key measures of climate security such as flood disasters, GLOF, wildfires, drought, migration of people due to climate change impacts, GHG emissions, drinking water shortages, and other impacts on human society.

3.3.5 Environmental security

Environmental quality is of utmost importance for public health, tourism, businesses, industrial development, foreign direct investment, ecosystem services, and sustainable economic development. Most cities in Nepal, including Kathmandu, are engulfed in air pollution, water pollution, and soil contamination. Transboundary air pollution has affected the visibility across the country impacting tourism. Unsafe disposal of hazardous and biomaterials including e-waste is spreading highly toxic substances which are often long-lasting in the environment. Negative consequences of pollution from urban areas are now spilling over to sub-urban and village areas. Environmental pollution affects ecosystem services such as clean air, clean water, nutrient cycling, food production, disease control, climate regulation, and

aesthetics. Poudel (2021a) proposed an environmental security framework for Nepal, which constitutes three main components: (1) Environmental pollution control, (2) Environmental assessment and remediation, and (3) Natural resources conservation. For environmental pollution control, a clear plan of action in addressing air, water, and soil pollution as well as pollution from specific sources such as solid wastes, hazardous waste, sewage treatment plants, Underground Storage Tanks, and stormwater is necessary. For environmental remediation, identification and assessments of contaminated sites, detailed investigation of pollution sources and the level of contamination, and the implementation of appropriate remedial measures are required. Governmental agencies and other concerned institutions must educate the public and promote its active participation in EIA processes for better environmental quality and sustainable natural resources. Nationwide natural resource conservation programs such as soil and water conservation, forest conservation, land conservation, land rehabilitation, riverbank protection, wetland conservation, and protecting water quality, constitute another integral component of environmental security.

3.4 Industries and Businesses

Nepal's unique conditions such as enthralling natural panoramic scenic views, the Himalayas, diverse climatic conditions, excellent agro-ecology for high-value crop production and seed industries, presence of diverse medicinal and aromatic plants, and the scenic and pleasant places for the development of residential areas and theme parks offer an extraordinary competitive advantage in tourism, agro-industrialization, herbal industries, and housing development in Nepal. Michael E. Porter (1998) has explained through his four-diamond model that creating a national competitive advantage of a nation depends on factor conditions (i.e. labor force, technology, capital, natural resources, infrastructure, government support), demand conditions, the company's strategy, structure, rivalry, and associated and supporting industries. National economic competitiveness is also linked with innovation and intellectual capital (Sahlberg and Oldroyd, 2010). Therefore, quality education is inevitable for sustainable economic development. Nepal has vast potential for businesses, tourism, and industrialization. Agro-based cottage industries such as organic coffee, cheese, leather products, handcrafts, garments, carpets, bamboo works, pickles, honey, woolen products, spices, fish, and dairy products can immediately generate employment and household incomes for rural families. The development of agro-based large industries

such as sugar factories, cotton industries, cigarette factories, jute mills, rubber industries, tea companies, paper factories, leather industries, and others is necessary for employment generation, economic growth, and sustainable economic development. Similarly, Nepal has immense potential for *Jadibuti* industrialization by manufacturing Ayurvedic and herbal medicines, j*adibuti*-based cosmetics and household products, organic pesticides, and herbal nutrition and dietetics. Because of the beautiful Himalayas, mesmerizing landscapes, unique culture and traditions, rivers and streams, flora and fauna, and very friendly people, Nepal is certainly one of the major tourism destinations for the global population. Therefore, tourism is a very viable and most lucrative industry generating employment and foreign exchange and contributing to the sustainable economic development of Nepal. Hydropower, forest-based industries, mines and minerals, health products, garments and carpets, and software industries are other potential avenues for industrialization in Nepal. Both the cooperatives and private businesses can meaningfully contribute to the industrialization of the nation (Poudel, 2018b).

3.5 Governance

Despite several political changes and the promulgation of the 2015 Constitution of Nepal which paved the way for federalized governance and mobilization of national resources through the federal, provincial, and local governments, Nepal's economic growth and awaited socio-economic transformation of the society is quite unsatisfactory (Poudel, 2024). Nepal struggles with food and energy security, clean drinking water, health services, quality education, employment, income generation, foreign debt, outmigration of youths, tourism development, infrastructure, environmental quality, and industrialization. Climate governance has become an essential component of good governance in Nepal. Climate change impacts such as temperature rise, erratic rain events, snow melts, GLOF, and frequent floods have become one of the major challenges of Nepalese society. Building community resiliency against natural disasters and protecting infrastructure, property, and human lives is urgent.

Good governance is critical for engaging local communities in resource management and development. It is necessary for building trust between political leaders and the common people, and for proper implementation and timely completion of developmental projects. Good governance calls for corruption control, social inclusion, and the formulation of appropriate laws, policies, and regulations to address the issues of ownership, tenancy rights,

and the use of natural resources. Poor infrastructure, corruption, and the government's inability to spend the available developmental budget in a timely and transparent manner are chronic problems in Nepal (Poudel, 2022). Under good governance, local communities and people can actively participate in decision-making and budget utilization for sustainable economic development. Poudel (2022) developed a seven-step Asta-Ja Governance Framework (Asta-Ja GF), which is a step-by-step, grassroots-based, inclusive, comprehensive, and participatory approach to enhance sustainable economic development in Nepal. These seven steps include (1) Status and linkages of Asta-Ja resources, (2) Resource ownership and tenure rights, (3) Policies, rules, regulations, and laws, (4) Community engagement, (5) Incentives and revenue sharing, (6) Investment in Asta-Ja infrastructure, and (7) Monitoring and evaluation and reporting. The first step in Asta-Ja governance is having a thorough understanding of the status and linkages of Asta-Ja resources through the system's perspective at various levels. The second step of the Asta-Ja GF relates to natural resource ownership and tenure rights. Despite the enactment of several acts defining ownership and tenure rights (Poudel, 2022), the natural resources ownership and tenure issues have not been fully addressed. The third step of Asta-Ja Governance Framework is understanding and recognizing various policies, strategies, laws, rules, and regulations related to Asta-Ja resources development and management (Poudel, 2009). The fourth step in Asta-Ja GF is community engagement. Nepalese society has a long history of resource governance at the local level, whether it is land, water, forest, or pastureland, and valuable Indigenous knowledge and technology exist in the society for natural resource management. The fifth step is incentives and revenue sharing. The sixth step is the investment in infrastructure such as drinking water supply, flood control, hydroelectricity, irrigation, forest products, agricultural development, land management, factories, etc. The seventh step in Asta-Ja GF is monitoring and evaluation.

Poudel (2011) suggested the design of an online Asta-Ja Investment Information System (AJIIS) (Figure 2) for promoting investments in Asta-Ja industries and businesses in Nepal. The AJIIS should be highly interactive and user-friendly accessible to standard web browsers and present potential Asta-Ja-related projects such as tourism, hydropower, agro-industries, forest products, medicinal and aromatic plants-based industries, etc., from a single portal. It is important to have a system that allows users to access, analyze, and download easily any statistical, GIS, satellite imagery, aerial photos, GPS, and other related information through web browsers. The availability of accurate information online about bio-physical, socio-economic,

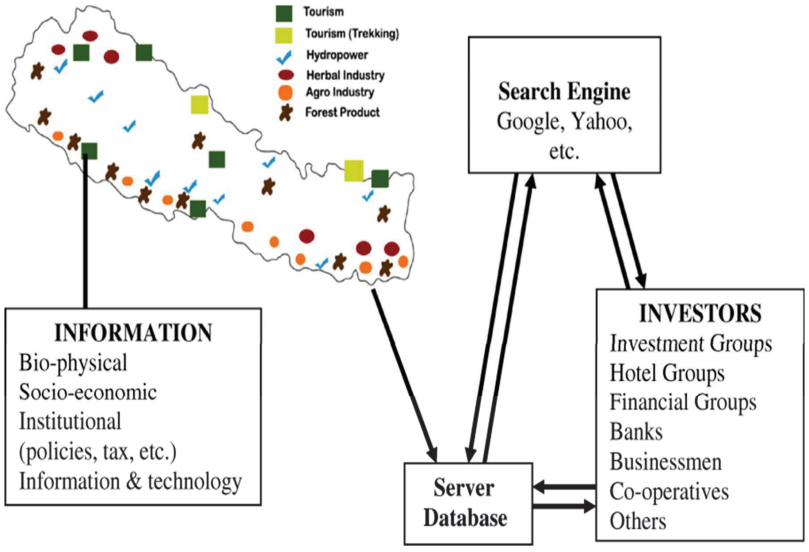

Figure 2 Asta-Ja Investment Information System (AJIIS) (adopted from Poudel, D.D. 2011. A Strategic Framework for Environmental and Sustainable Development in Nepal, *Int. J. Environment and Sustainable Development*, 10(1): 48–60; page no. 57, Figure 1).

institutional, informational, and technological aspects of Asta-Ja investment projects would help potential investors assess their investment portfolios and make quick decisions on such projects.

4 Integrating Asta-Ja and Education

Ecological and environmental sustainability is the foundation for successful businesses, employment creation, innovation, and sustained economic growth. Transformation of an educational system for sustainability and sustainable economic development requires an in-depth understanding of the national natural resources, educational needs, appropriate education policies, public and private institutions in education, institutions for research and innovation, affordability and access to education, the global educational atmosphere, and the philosophy of education. In higher education, the challenges for quality education often revolve around academic excellence, implementation of sustainable educational practices by the institutions of higher education as role models, the synergy between the public and private educational systems (Alam, 2023), the timely adjustment and modification of

the structure, curricula and the pedagogy, and good governance in education. The Asta-Ja Framework offers a very timely and practical guideline for integrating the Nepalese educational system with natural and human resources, cultures and traditions, history, geography, geology, economic development, and other facets of Nepalese lives. The five themes of the Asta-Ja Framework discussed above (1) Theory and principles of Asta-Ja, (2) Asta-Ja assessment, (3) Security challenges, (4) Industries and businesses, and 5) Governance serve as the critical elements for the integration of the Asta-Ja Framework and Nepalese educational system for practical education in Nepal. Integration of the Asta-Ja in the Nepalese educational system presents an immense opportunity for the transformation of Nepal's education system to sustainability and sustainable economic development in a practical way.

5 Conclusions

Nepal's educational development initiatives fall into three eras, (1) the Pre-Democracy era (before 1951 AD), (2) the Democratic Governance era (1951–2008 AD), and (3) the Federal Democratic-Republican era (2008 AD onward). While there were remarkable but limited undertakings in educational development during the Pre-Democracy era, major activities in nationwide educational development started after the dawn of democracy in 1951 AD. Despite Nepal's sustained and remarkable efforts in developing its educational sector for nation-building, Nepal's education and training still need a massive overhaul and transformation. Currently, it is highly fragmented, uncoordinated, and lacks appropriate curriculum and educational and training frameworks. There is an urgent need to develop an educational system that is engaging, coordinated, comprehensive, problem-solving, and enhancing learners' critical thinking skills for addressing current and future challenges. The Asta-Ja (*Jal* (water), *Jamin* (land), *Jungle* (forest), *Jadibuti* (medicinal and aromatic plants), *Janashakti* (human resources), *Janawar* (animals), *Jarajuri* (crop plants), and *Jalabayu* (climate)) Framework which is an all-encompassing, peaceful, and comprehensive sustainable environmental and natural resources development approach offers a great opportunity for integrating Nepali educational system to natural and human resources, culture and traditions, geography, and other facets of Nepalese lives for an expedited fast-paced socio-economic transformation and sustainable economic development while enhancing ecological and environmental sustainability in Nepal.

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