Asta-Ja USA Newsletter

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Message from the President

Greetings!

Dr. Durga D. Poudel
President, Asta-Ja USA

It is my great honor and privilege to present the second newsletter from Asta-Ja USA. As the mission of our organization is to promote sustainable development of natural and human resources through education, capacity building, charitable activities, applied research, policy decision support, and environmental conservation, Asta -Ja USA is continually striving for excellence in generating funds and implementing research, development, and community awareness programs to enhance sustainable development of these resources and the environment.

Asta-Ja is a theoretically grounded grassroots-based planning and management Framework for conservation, development, and utilization of natural and human resources. Asta-Ja means eight of the Nepali letter "*Ja*" [*Jal* (water), *Jamin* (land), *Jungle* (forest), *Jadibuti* (medicinal and aromatic plants), *Janashakti* (manpower), *Janawar*, (animals), *Jarajuri* (crop plants), and *Jalabayu* (climate)]. Asta-Ja promotes accelerated economic growth and socio-economic transformation of the nation. It is a scientific, holistic, systematic, self-reliant, and multidisciplinary Framework for the conservation, development, and utilization of Asta-Ja resources. The Asta-Ja Framework encompasses the elements of each of the four subsystems of the planet earth system: hydrosphere (*Jal*), lithosphere (*Jamin*), biosphere (*Jungle, Jadibuti, Janashakti, Janawar, Jarajuri*), and atmosphere (*Jalabayu*). The eight elements of the Asta-Ja system are very intricately linked and strongly connected. Hence, it is important to have sustainable conservation and development of each of the eight elements of Asta-Ja for better functioning of the entire system. The Asta-Ja Framework has eight principles for its practical application: 1) community awareness, 2) policy decision making, 3) community capacity-building, 4) interrelationships and linkages, 5) comprehensive assessment, 6) sustainable technologies and practices, 7) institutions, trade and governance, and 8) sustainable community development and socio-economic transformation. Fundamentally, Asta-Ja Framework is for the highest quality of living in harmony with the nature.

I would like to thank the Board of Directors and Executive Officers of Asta-Ja USA, Asta-Ja members associated with other Asta-Ja organizations including Asta-Ja RDC, Asta-Ja ICC, Asta-Ja Abhiyan Nepal, Asta-Ja Agriculture Cooperative, and Asta-Ja Vyas Bhumi Nepal, and all other Asta-Ja Campaigners as well as individuals and organizations who have been involved heavily on sustainable conservation, development and utilization of Asta-Ja resources for economic growth, environmental quality and socio-economic transformation of the communities.

As COVID-19 that began late 2019 from Wuhan, China, has reached 210 countries and territories infecting 1,924,679 people and claiming 119,692 lives globally by April 13, 2020, we extend our heartfelt condolences to the families who have lost their loved ones and salute doctors and nurses and all individuals in the front lines fighting against this pandemic. We wish safe and healthy life to every individuals.

Please visit our website www.astjausa.org for more information.

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Inside this issue

Editorial

Nepal's Vast Water Resources and Agriculture

Nepal is world's second richest country in water resources. It is estimated that Nepal has 237 km^3/year of water in various forms, including groundwater, lakes, rivers, snow, and springs. There are more than 6,000 rivers making 45,000 km in total length; 1,000 of them are more than 10 km long and 24 of them are 100 km long. Based on their origins, rivers in Nepal are classified into three categories: 1) Himalayan based, 2) Mid-mountain or hilly region based, and 3) Low-hill or Siwalik (Chure) region based. Rivers originated from Himalaya include Koshi, Gandaki, Karnali, and Mahakali, and are the permanent sources of water in Nepal. They contain almost 78% of the total river water resources in the country. Rivers originated from mountain and hilly regions such as Mechi, Bagmati, and Rapti contain about 9% and the rivers originated from Siwalik region contain remaining 13% of the total river water resources in Nepal. These river systems keep very high value in nation's agricultural, power, tourism, recreational, ecological, transportation, and socio-cultural development.

Nepal is an agricultural country employing more than two-third of the national population and contributing nearly one-third to national GDP. Historically, Nepal was self-sufficient in food production, and until in early 1990s, Nepal used to export rice to other countries including India. However, in recent decades Nepal's food demand is met largely through imports. While declining agricultural productivity, land use changes, and out-migration of workers include some of the factors responsible for poor agricultural production in the country, lack of irrigation and recurrent drought conditions constitute the fundamental constrains to agricultural production in Nepal. In this regard, irrigation becomes a single most important factor of agricultural development in the country. For example, prolonged droughts of 2005 and 2006 caused a substantial loss in cereal production, which could have been avoided through proper irrigation facilities. It is sad that despite Nepal Government's high priorities for irrigation development since as early as 1950s and the existence such a vast amount of water resources, only 17% of the total cultivated land currently has year-round irrigation facilities. Majority of nation's agriculture is still rainfed.

Three basic components of increased agricultural production include: 1) Quality seeds of improved variety, 2) Year-round irrigation, and 3) Soil quality. All three components are within our reach if we manage available resources wisely. The first component- quality seeds of improved varieties can be provided not by introducing new seed companies but by strengthening our existing research and extension system, and training our farmers on vegetable and cereal seed production and maintenance. Technology developed at national and regional levels can be transferred trough existing extension agents. Nepalese farmers are quite eager in adopting new technologies. With some training and appropriate governmental support, they can produce seeds, commercialize them, and export to other countries. This is particularly important in the case of vegetable seeds. Due to their bulkiness, cereal seed production could be for local and regional supplies. With year-round irrigation, crop intensity and crop diversity can be increased. This offers better economic opportunities. The third component, soil health, is also associated with crop diversity because growing diverse crops help to increase microbial activity, increase nitrogen content and soil properties. The message here is that these three components can drastically improve Nepalese agriculture. Assured irrigation has a pivotal role in Nepal's agricultural development. While many Middle-eastern or African countries are struggling with lack of fresh water availability for irrigation and they have to purify their waters for irrigation, Nepal has not been able to simply utilize its widely available freshwater resource by making irrigation canals to meet nation's agricultural needs. We are wasting the proper use of our valuable water resource every second. It is already too late!

Dr. Dilip R. Panthee
Asheville, North Carolina, USA

Role of safe drinking water in public health cannot be overemphasized. Inadequate water availability and questionable quality of supplied water can increase the risk of various disease outbreaks. Water scarcity is more prevalent in the rural areas in both the mountains and Terai regions. Major improvement is necessary in supplying safe drinking water in both the urban and rural areas.

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Water Resources Management

Most Nepalese including myself were taught that Nepal is rich in water sources with a total generation potential of about 83,000 MW; this is a very narrow and misleading statement. Water in Nepal keeps very high religious, cultural, social and historical significance. From birth to the death, Nepalese life revolves around the rivers and lakes. Therefore, measuring the significance of water resources in Nepal only in terms of hydropower and dollar value is grossly misleading. Nepal is blessed with vast water resources including pristine lakes in the Himalayas (places of pilgrimages), holy rivers, mountain springs, hot springs, ground water and mighty rivers flowing from north to south. The school and college curriculum should be revamped such that people understand and appreciate water resources from cultural, religious, and social perspective, not just based on their monetary values.

Although both lakes, Gosaikunda and Rara, are located in the Himalayan region, for a person visiting them will have two contrasting objectives. While Gosaikunda has a very high religious significance, the Rara lake has a very high tourism value. Therefore, it is important to designate water resources in Nepal as religious, cultural, and economic resources and manage them accordingly. Haphazard uses of water resources must be stopped immediately. If a resource is classified as a religious or cultural resource it should be kept off limits from developers and individuals. It should be the responsibility of the local/state/federal governments to maintain the sanctuary of such rivers, lakes and places. For example, if the Bagmati River is classified as the river of cultural and religious significance, then why the government not banning the dumping of untreated sewerages and toxins into the river? Along with the classification of water resources, it is critical to identify its owners and stakeholders for its sustainable management and development.

Harnessing water resources for irrigation or hydroelectric power is much easier said than done. It requires skilled engineers and planners, capital, political leadership and public support. All the rivers originating from Nepal or those originating from Tibet and transitioning through Nepal join River Ganga in India, making them multinational entities. The groundwater basins in Nepal and India are interconnected from east to west. This means it is a regional asset with limited ownership. The government needs to provide a clear guideline or assurance on the portion of ownership and liabilities on such multinational entities. Are there any bi-lateral treaties between two countries for water uses? What are the international laws defining water uses of rivers passing through multiple countries? Nepal's engineers and bureaucrats should be sufficiently trained in transboundary water issues so that they can negotiate effectively with their Indian counterparts.

Dr. Ganesh Pandey
Supervising Engineer
California Department of Water Resources
Sacramento, CA, USA

A successful hydropower project requires meticulous planning, in-depth hydrologic and geologic studies, engineering design, construction planning and execution, project financing, establishment of operation and maintenance protocols, repayment of the project cost and identification of target users. When the government undertakes a project on its own or it licenses to others it should come with a clear policy on meeting its environmental obligations. A water project impacts both to its immediate locality as well downstream. If a regional government, in Nepal's case it is India, finds major issues with such a project, then the entire planning effort will be wasted. There is a need to redesign engineering education of Nepal, as the current system lacks many aspects of civil engineering.

A hydroelectric project is a major source of risks. While some risks and their impacts are localized, other risks, such as distressing of dams, involve major catastrophes with severe impacts downstream. Therefore, for every project, Nepal government needs to come up with the best possible design to assure the safety of downstream residents. In case of eventualities, the government should come up with a detailed emergency action plan and resources meeting international norms. For every project, government should prepare a lesson-learned brochure to highlight pro and cons of the project.

Government should be extra-careful in accepting foreign aids. For example, the Prithivi Highway is considered one of the dangerous roads in the world, and it is draining majority of Nepal's road repair budget. This is because the road is built on the geologically weakest areas following the banks of the rivers and streams. The road alignment has destroyed multiple potential dam sites and the economic viability of the river system. Only time will tell whether it was an engineering blunder of a planned action, but Nepalese are suffering and paying the prices!

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Kathmandu Valley Groundwater

Source:www.arcgis.com

In middle sixth century, stone waterspouts (dhunge dhara) served as major source of water in the Kathmandu Valley . Irrigation canals (Rajkulos) served as the major source of surface water. In recent decades, the Kathmandu Valley has experienced a sharp increase in its population due to out migration from rural areas. Nepalese from other parts of the country migrate to the city of Kathmandu for better opportunities. Available statistics shows that the population of Kathmandu Valley increased from 1.6 million in 2001 to over 2.5 million in 2012. The built-up area has also increased immensely. Vegetated areas that serve as recharge areas for the Kathmandu Valley groundwater have increasingly disappeared due to new developments. Conversion of vegetated recharge areas to urban and industrial is causing groundwater pollution. Additionally, water demand in the valley has reached 337 Millions of Liters Per Day (MLD), with the current supply reaching only 120 MLD in wet season and 73 MLD in dry season. Many water sources in the valley are highly polluted.

The groundwater as a source of drinking water is highly vulnerable due to the presence of high iron concentrations and coliform bacteria. The WHO limit for iron in drinking water is 1.9 mg / L, but the groundwater in Kathmandu Valley often exceeds the limit due to high level of natural concentration of iron found in the valley's soil. Several studies have shown very high level of coliform contamination in shallow wells exceeding the WHO standard limit. Similarly, drinking water coming from shallow and deep wells often show elevated nitrate and ammonia concentration s. Septic tanks, sewage, and agriculture are some of the major sources of water pollution in Kathmandu Valley.

Kathmandu Valley consists of three of Nepal's largest cities: Kathmandu, Bhaktapur, and Lalitpur. Together, bounded on all sides by the Mahabharat Hills, these cities cover an area of approximately 656 km^2. The average altitude of the Kathmandu Valley is about 1,350 m above sea level. The valley has an average annual temperature of 18°C and an average rainfall of 1,500 mm (climate-data.org). More than 80% of the rainfall occurs between June through September (Pandey et al., 2010). Approximately 1.2 billion m^3 of precipitation falls on Kathmandu Valley annually; if only 10% of this water is utilized by anthropogenic sources, the remaining 90% (around 128 million m^3) could act as recharge (Shrestha et al., 2009). The total groundwater extraction went over 25.5 million m^3/ year by 2009, resulting in extraction being greater than recharge (Pandey et al., 2012). The possible major causes groundwater decline are anthropogenic encroachment, built-up lands, land use and land cover change, and over extraction of groundwater, which creates cones of depression. High industrial development with some commercial and private sectors like hotels and household s has led to the overdraft and decline of the groundwater in the valley. As a result, the risk of land subsidence in the areas has increased (Pandey et. al, 2010). Moreover, damage to vegetation and surface water that is hydrologically connected to groundwater aquifers can decline due to reduction in quantity and quality of groundwater (Jones et al., 2011). Poor management of declining traditional water sources, surface water insecurities, lack of coordination between different actors using and governing both water and land, and lack of groundwater management policies are complex factors that has increased the groundwater exploitation in the Kathmandu Valley (Shrestha et al., 2018).

Ms. Sarala Gautam
Graduate Student
University of Louisiana at Lafayette
Lafayette, Louisiana, USA

The Groundwater Policy for Kathmandu Valley was approved by the cabinet in June 2012, but the policy is only limited to the licenses issuance and legalizing extractors. Out of 1000 estimated tube wells by Kathmandu Valley Water Supply Management Board (KVWSMB), only about 414 were licensed by 2016 (Shrestha et al.,2018). Strong policy development and permitting systems can play an important role in groundwater management. Water deficit issue of Kathmandu Valley should be addressed effectively through strong coordination of social, institutional, governmental and political sectors of the country Preservation of traditional sources of water like stone spouts, springs and canals can reduce the stress of groundwater demand. The government needs to give high priority to groundwater management by effectively handling urbanization and vegetation management in the Kathmandu Valley. (References can be provided on request).

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Green Infrastructure in Kathmandu, Nepal

Ms. Katherine Eddings
Graduate Student
University of Louisiana at Lafayette
Lafayette, Louisiana, USA

Green Infrastructure refers to any infrastructure, usually related to water management, implemented in a way that uses natural or semi-natural areas (What is Green Infrastructure?, 2017). There are several benefits to implementing this type of infrastructure including but not limited to being cost effective, resilient, providing recreational spaces, and increasing the property value of the surrounding areas. It also reduces air pollution by filtering particulate matter, lowers the ground level ozone by reducing the urban heat island effect and provides habitats for small wildlife (Chunn-Heer, 2019). There were some characteristics of Green Infrastructure already commonly being used such as rooftop gardens and rainwater harvesting in the city of Kathmandu (Corwin, et al, 2019).

Rooftop gardens are generally used to provide families with vegetables, easing economic strain, but they also decrease the amount of runoff during storms. The amount of water retained is generally small and depends on the size and amount of pots used in the garden, as well as the size of the garden itself. However, in Kathmandu where almost all the buildings have one, the amount of potential runoff was noticeably higher than the actual amount of runoff noted (Corwin, et al, 2019).

Rainwater harvesting is another commonly used method of using storms to lessen the water shortage in the city. A common system used today involves a catchment area, conveyance pipes, and a storage jar. Homes and businesses alike have this system or one similar, closing the gap between the water need and water available (Corwin, et al, 2019).

There are retaining walls along both sides of the stream in the Dhobi Khola watershed in the city of Kathmandu, to protect the nearby residents and businesses from flooding. They were constructed of soft stones, such as limestone, approximately four years ago. The differences in the water quality as you travel upstream were alarming. At the confluence of the river the water had an oily sheen and froth to it, was full of trash, and approximately half of the vegetation on the forming banks was dead. There was no life in the water and the mixing of water from the Dhobi Khola and Bagmati River was obvious, due to the color differences. As you traveled upstream the channel narrowed, therefore flooded more easily. While the public was not supposed to dump trash there, many still did, leaving it filled with garbage. There was a man who cleaned out some trash once a week attempting to help the situation. The water had a dark brown color with milky spots and fecal coliform present. Further upstream there were cows in the river drinking from it despite it being dark brown, full of trash and bearing a high sediment load. The cows also indicated a high probability of fecal coliform. Alongside the river were roads that were built up approximately 3 to 4 feet higher than the nearby businesses. In times of flooding, which was likely, as there was nothing present to slow the water flow, these businesses would flood first. It was also noted that the walls were deteriorating, showing significant signs of erosion, such as the base of stairways likely meant for maintenance use, being severally undercut (Corwin, et al, 2019).

At Bhangal, upstream just outside the city where the walls began, the water was noticeably less brown and milky. There was little to no trash, and there was natural vegetation growing along the river. The walls concentrated the flow, and the turbidity was low, however the effects of this was not apparent at this location. Some locals were seen swimming in this area as well (Corwin, et al, 2019).

The utilization of rooftop gardens and rainwater harvesting has been essential for Kathmandu and continuing these practices would continue to benefit the area. The retaining walls along the Dhobi Khola watershed are only four years old but have shown to be detrimental to the ecosystem and unsustainable. Not only is the river polluted, but the walls channelize the river, increasing the erosion on the walls themselves and decreasing their longevity. Adding vegetation mats with native vegetation along the base of the walls would not only provide protection from erosion, allowing the walls to last significantly longer, but assist in flood protection. The vegetation would slow and absorb some of the water (Corwin, et al, 2019). (References will be provided on request).

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Air Pollution in Kathmandu, Nepal

Air Pollution is one of the greatest threats to the well being of many developing countries, this is especially true for Nepal. Chronic exposure to poor air quality decreases the life expectancy of a population. Different constituents of concern have different sources, impacts, and pathways of exposure. Two important constituents of concern are tropospheric ozone (O_3), and particulate matter ($PM_{2.5}$). The majority of ozone in our atmosphere (composed of the troposphere, stratosphere, mesosphere, and thermosphere) is found in the stratosphere, where it plays a key role in reducing the amount of ultraviolet (UV) radiation that makes its way down to Earth's surface. The ozone in the stratosphere poses no concern to human health, however ozone can form at the tropospheric or ground level. In order for ozone to form at the ground level: there must be an abundance of nitrogen oxides (NO_x) and sunlight present.
The two largest anthropogenic sources of NO_x are from biomass and fossil fuel burning. Once the NO_x has been emitted it undergoes a process known as photolysis. During photolysis, a 400nm wavelength light photon will split a single bond between nitrogen and oxygen. This free oxygen will readily bond with diatomic oxygen (O_2) leading to the formation of O_3.

The health impacts of ozone can range from those that are felt immediately to others that have long term consequences. According to the American Lung Association, instantaneous effects of ozone include but are not limited to shortness of breath, wheezing, and/or asthma attacks (American Lung Association, 2020). Individuals with pre-existing conditions will be much more sensitive to the presence of ozone. Short term exposure will increase the instances in which individuals with pre-existing pulmonary conditions, such as chronic obstructive pulmonary disease or asthma, will need to go to the hospital in order to seek immediate medical treatment (Gent et al., 2003). Consequences of long term exposure may include reproductive harm and have been linked to lower birth weight and decreased lung function in newborn infants (Salam et al., 2005). Both short term and long term exposure increases the likelihood of premature death.

Particulate matter ($PM_{2.5}$, PM_{10}), on the other hand, is a much broader term. Instead of being classified by their chemical composition, they are classified by the diameter of the particles and include particles of varying chemical composition and physical states. The size of the particle is important in determining the transport, deposition including penetrance into the human or animal body, and sources of the particles. A particle that falls under the category of PM_{10} is a particle that is within the range 2.5-10µm in diameter. A few examples of a PM_{10} particulate could be weathered silt carried in suspension from a construction site, ash given off from biomass burning, or plant particles such as pollen. $PM_{2.5}$ is a particle that is less than 2.5µm in diameter. For example, in the United States Rocky Mountain region the city of Denver often suffered from the "brown cloud" in the winter time, aerosolized fine particulates generated by car tires grinding soil and unconsolidated rock material on road surfaces. A few other sources for these particles could be clay that is suspended during mining operations, heavy metals and chemicals from vehicle exhaust, or smoke from biomass burning. Particulate matter has varying health impacts depending on the diameter of the particle and the classification they fall under. According to the American Lung Association, PM_{10} particles are inhaled into our respiratory system (nose and mouth) and are small enough that the particles are not expelled whenever we cough or sneeze (American Lung Association, 2020). These particles get trapped within the upper region of our lungs causing sublethal effects, such as reduced lung function growth due to tissue damage and lung inflammation (Gauderman et al., 2002). $PM_{2.5}$ is much more dangerous because these particles are smaller and can be deposited much farther into the lungs causing damage to the small airways of the lungs. Chronic exposure to particulate matter causes early death, increased cardiovascular disease, severely worsens the effects of asthma and other chronic lung diseases such as emphysema and COPD(Salam et al., 2005).

Mr. George Bybee Bailey
Senior Undergraduate Student
University of Louisiana at Lafayette
Lafayette, Louisiana, USA

The Data from the United States EPA's AirNOW program with measurements taken every hour from the U.S. Embassy in Kathmandu, Nepal, show $PM_{2.5}$ concentrations consistently exceeding the unhealthy threshold in the months of November through May. Ozone never crosses the 70ppb set threshold by the US EPA, this however does not mean it's harmless. As stated earlier in the article the impacts of ozone are more severely felt by individuals with pre-existing pulmonary conditions. The elevated levels of particulate matter could irritate an individual with asthma or COPD, causing it to flare up also requiring hospitalization of the individual.

Reducing air pollution is a multifaceted issue. Data can be generated constantly, showing trends and highlighting the impacts, but the only way air quality will improve is through education and regulation. Individuals can take action in their daily lives to reduce their contributions to air pollution by reducing their fossil fuel consumption, for example: carpooling, riding public transportation, or biking. One way to reduce the contributions from biomass burning is to find better uses for this material such as composting or urban gardening. This can only be accomplished through the education of the general population to affect a change and a universal paradigm shift in the long engrained use of carbon resources. (References will be provided on request).

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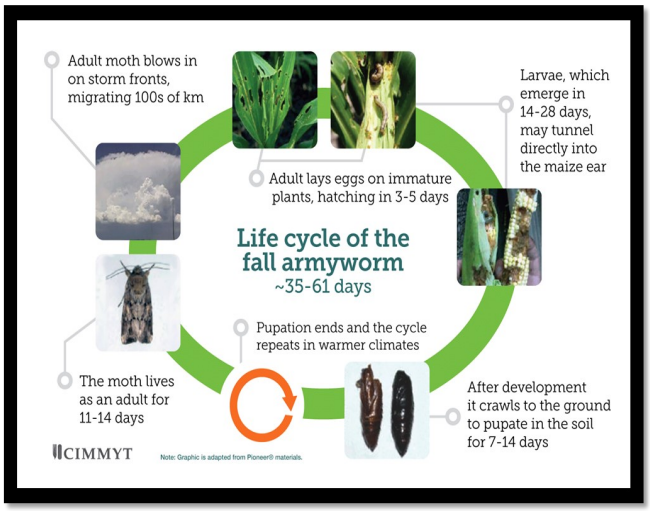
Invasive pest: Fall Army worm *(Spodoptera frugiperda)*



Source: CIMMYT.

Armyworm *(Spodoptera frugiperda)* is native to tropical and subtropical Americas (from the USA in the north to Argentina in the south), where it is known as Fall armyworm (FAW) (where four seasons of a year is named winter, spring, summer, and fall). For the rest of the world, it may be called American armyworm, in reference to its origin. It was detected in Western Africa in 2016 and India in 2018. By 2019, it has spread to many other Asian countries, including Nepal. This pest can feed on over 350 plant species from 76 plant families. The highest numbers of plants are included from the grass family (106), sunflower family (31), and beans family (31). Among the economically important crops maize, rice, sorghum, sugarcane, cabbage, beet, peanut, soybean, alfalfa, onion, cotton, pasture grasses, millet, tomato, and potato (CABI 2017).

Like any other moth, there are four stages in its life cycle: egg, larva, pupa, and adult. It can complete its life cycle in 30 days in warm season, whereas it can take up to 60 days in the cooler season. The female moth, lays eggs in mass, usually in the undersurface of the leaves. Each mass usually contains 10-200 eggs, covered by its scale. They may be laid in a single layer or in multiple layers superimposed on each other. A single female moth can lay up to 2000 eggs in its lifetime. Upon hatching, the larvae begin to feed on a suitable host. The larval stage is the destructive stage. Larvae of FAW can be identified by the presence of three yellowish stripes running down the back, a wider dark stripe and a wavy yellow-red blotched stripe on each side and predominant white, inverted Y-shaped suture on the head. Four dots on the tail end of the body make a perfect square shape.

Dr. Raju Raj Pandey
California, USA

The general life cycle of *S. frugiperda* includes a larvae going through repeated molting; there are six instars in its life cycle. Earlier instars feed near the site of egg hatching, whereas the later instars migrate to upper parts of maize entering deep into the whorl. The first four instars do little damage, but later two instars do most of the damage. Over 90% of damage is caused by the fifth and sixth instar larva. They are called ***armyworms*** because they can eat all plant matter they encounter in their wide dispersals, like a large army. Fully developed larva enters the soil and pupates. Within one to two weeks, the adults emerge from the pupa and begin a new cycle of destruction. Adults survives for about 10-15 days.

This insect cannot overwinter in areas where the temperature goes below freezing point. In the USA, it survives only in the southern states (Texas, Florida, etc.), but it can spread to northern states and Canada. This pest can travel more than 100 km in a single night. It can disperse about 500 km in each generation. It reaches the major US corn belt in June or July (Corn Belt include Iowa, Illinois, Missouri, Indiana, eastern Kansas, western Ohio, eastern Nebraska, and southern Michigan). Insecticide application is practiced as necessary for its control.

Previous studies from elsewhere have shown that this pest cannot survive freezing temperature, does not undergo diapause, and larval stages are cannibalistic (thereby help reduce their population). This pest has high reproductive ability and adults can disperse long distances. Following its invasion into Africa and Asia (including Nepal), it has established as a major pest of maize and many other crops due to the favorable environment (warm temperature) and availability of suitable food (maize, sugarcane, rice, etc.). While expanding its area of invasion, it has also escaped from the attack by its natural enemies found in the native range. However, they have been attacked by a wide variety of predators and parasitoids, found in the newly invaded areas. However, the control level achieved by these generalist predators is inadequate. Chemical pesticides may be used to protect the crop from damage; however, it does not provide a sustainable solution in the long run (both economically and environmentally).

Wide host range, high reproductive rate, and ability to disperse long distances within a short period puts pest eradication out of the question, leaving integrated pest management as the only viable option. Some of the strategies used against invasive pest to develop IPM techniques include pest detection and implementation of quarantine, pest population monitoring across various agroecological zones, surveying resident natural enemies attacking the invasive pest and its impact on pest population, possibility of importation of natural enemies from native range, determination of economic threshold and identification of plant growth stages that require protection. Identification of effective pesticides (biological and chemical) also are required to integrate them into the ultimate strategy of integrated pest management (IPM).

Pest detection: Before any pest can be managed, it is imperative to understand its biology and behavior fully. Information on pest distribution, survival, and population dynamics across various agroecological zones needs to be gathered. In its native region of the USA, the pest survives only in the southernmost areas of Florida and Texas and takes time to reach the main corn production areas. Nepal has a wide diversity of climatic variations (largely due to altitudinal differences). We need to know where the pest survives in the winter. This information will help to understand the survival pattern and seasonal distribution of pest, which will help to adjust planting time and determine the application of crop protection measures.

Pest monitoring: In subtropical and tropical areas of Nepal and India, it can survive in most of the places except the high Himalayan belt. Light trap and pheromone traps are the two most common methods employed for monitoring adult moth activities. Pheromones are more specific, whereas light traps attract a large variety of insects requiring proper identification of desired species. Once adult moth activities are noticed, infestation on plants should be conducted looking for egg masses and larvae. Because eggs are laid in masses, it should be easily visible. Larvae usually feed at the central whorl leaf where pest damage, as well as its fecal materials, can be seen.

Biological control: One of the main reasons the invasive organism outbreaks as a serious pest is due to the lack of effective natural enemies that used to keep it under control in the native range. More than 150 natural enemies of *S. frugiperda* have been reported from the Americas, and the Caribbean region (Molina-Ochoa et al., 2003). Those natural enemies are left behind when this pest invaded Africa and Asia. Many generalist predatory and parasitic insects jumped to attack the newly invaded pest in Africa (Tefera et al., 2019) and possibly in Asia. Its larvae are cannibalistic, especially when there is a food shortage, but its impact is negligible. Many vertebrates and invertebrate predators such as birds, rodents, lizards, and other insects can prey upon its larvae, none of them provide adequate suppression of this pest. Several fungi, bacteria, and nematodes are also associated with this pest. *Bacillus thuringiensis* is the most promising microbial agent. Recently, research conducted at the Tribhuwan University reported preparation with multiple species of bacteria provided adequate suppression of FAW in the field.

The most commonly used parasitoids belong to *Trichogramma* and *Telenomus* species due to their effectiveness and ease in rearing. *Trichogramma* is much smaller in size and may have difficulty to reach all the eggs if they are laid in multiple layers. *Telenomus* was found more effective compared to *Trichogramma* under such circumstances. *Telenomus remus* can parasitize eggs on both the layers. Innundative releases of *T. remus* has provided up to 90% parasitism and effective control of *S. frugiperda* in Venezuela (Ferrer, F., 2001). Among the larval parasitoids, *Archytas marmoratus, Cotesia marginiventris*, and *Chelonus texanus* are more common (Sidhu and Muniappan, 2017).

Various species of *Trichogramma* are found in Nepal attacking other lepidopterous pests. Surveying for resident egg and larval parasitoids associated with *S. frugiperda* along various agroecological zones will help to identify if any of the resident beneficial insects is helping suppress *S. frugiperda* population. In addition, a process for the importation of *T. remus* must begin as soon as possible.

Chemical control: In the USA, where it is native, much of the control is achieved through chemical pesticides. The pest does not survive winter cold in the major corn belt. As a result, the crop may avoid infestation during a more vulnerable growth stage (early vegetative stage). Various contact insecticides may be applied to suppress the larval population when the infestation level crosses 5% of the plants. As the larvae feed inside the leaf whorls and cob, control is difficult. High volume spray may be necessary to reach deep into the whorl. In Florida, farmers tend to apply pesticides daily during the silking stage to prevent larvae from entering inside the cobs. Pesticides of a different mode of action should be rotated to avoid pesticide resistance.

Integrated Pest Management (IPM): Reliance on chemical pesticides alone is neither economically nor environmentally sustainable. The IPM is the most desirable pest management method that incorporates all the possible options of pest management, including cultural, mechanical, physical, biological control methods, and using chemical methods as a last resort. Various studies conducted in Africa and America with smallholder farmers may be of great help in developing an IPM strategy suitable for Nepali farmers. Selection for tolerant varieties, adjustment of planting time, trap cropping (with younger seedlings), mix cropping (with beans) may help minimize the extent of the damage. Application of ash or sand inside the leaf whorl has shown some promise. Researches conducted elsewhere have shown that the most important pillar of IPM against *S. frugiperda* is biological control through the promotion and conservation of its natural enemies. Evaluation of augmentative releases of mass-reared indigenous *Trichogramma* should begin immediately. The process to introduce and evaluate *Telenomus remus* should be initiated soon. Determination of economic threshold and identification of pesticides (including microbials) that are effective and least disruptive to the natural enemy populations will eventually help manage the pest more sustainably. (References will be provided on request).

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Asta-Ja USA would like to extend warm wishes on auspicious occasion of Nepali New Year 2077 B.S.

Asta-Ja USA Family

Asta-Ja ICC PRESS RELEASE on COVID-19 Pandemic

On March 28, 2020, Asta-Ja International Coordination Council (Asta-Ja ICC) hosted its First Global Virtual Meeting and discussed COVID-19 pandemic and Asta-Ja initiatives to fight against the pandemic. More than a dozen Asta-Ja ICC members representing Australia, Canada, and USA attended the meeting. Dr. Durga D. Poudel, Chairman of Asta-Ja ICC and the host of the virtual meeting provided an update to the participants on Asta-Ja organizations (Asta-Ja Research and Development Center (Asta-Ja RDC), Kathmandu, Nepal, Asta-Ja Abhiyan Nepal, Kathmandu, Nepal, and Asta-Ja USA, Hawaii, USA) and their current activities. Dr. Poudel briefly discussed recent projects through Asta-Ja USA such as Organic Vegetable Production Project in Tanahu, Chunder Drinking Water Project in Tanahu, NRNA NCC USA funded Environmental Community Awareness Project in Kathmandu, and the establishment of Center of Excellence for Environment and Climate Change in Kathmandu. He also shared agenda with the group for discussion: 1) COVID-19 Emergency Fund, 2) Documentation of global experience on COVID-19 pandemic, and 3) Strategic planning (economy, society, and community) and agricultural development. The meeting decided an immediate Press Release from Asta-Ja ICC showing our position on COVID-19 pandemic highlighting various concerns/issues and the country's overall development following this pandemic: How do we position ourselves to help the country? What socio-economic and ethical issues do we have to address in the Post COVID-19 era to strengthen Nepal's Resiliency, etc. It was agreed that the executive committee would formulate and release a press release within next few days, which has already been done. The Press Release has highlighted three major activities: COVID-19 Emergency Funds, documentation of global experience on this pandemic, and Post-COVID-19 Resilient Nepal Convention as immediate and high priority activities for Asta-Ja this time. For a copy of the press release, please click on the link https://img1.wsimg.com/blobby/go/c20df895-a248-4428-b32e-8960577b8de0/downloads/ASTA-JA%20ICC%20PRESS%20RELEASE%20APRIL%2004%2C%202020.pdf?ver=1586273046688

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Center of Excellence for Environment and Climate Change

On December 16, 2019, with support from NRNA NCC USA, Community Environment Academy, and Asta-Ja USA, a one-day workshop on Center of Excellence for Environment and Climate Change was organized by Asta-Ja Research and Development Center in Kathmandu, Nepal. Experts and researchers engaged in the field of climate change and environmental quality were invited. The workshop ended with the establishment of the Center of Excellence for Environment and Climate Change with an 11-member Working Committee. *****

Viruses and Public Health

Prakash Neupane, MD
Program Director Hematology/ Oncology Fellowship
Associate Professor of Medicine
The University of Kansas Medical Center, Kansas City, KS, USA

Going "viral" on the internet has become the usual desire of many individuals now, but when a pathogenic virus decides to go "viral" it causes catastrophic damage to human civilization. Virus is the smallest infectious agent that requires a living cell to replicate. Viruses can infect all types of lives including animals, plants, microorganisms, and bacteria. Viruses need living cell to survive, but a virus is not a complete cell by itself. Viruses teeter on the boundaries of what is considered a life. On one hand, they contain the key elements that make up all living organisms: the nucleic acids, DNA or RNA (any given virus can only have one or the other). On the other hand, viruses lack the capacity to independently read and act upon the information contained within these nucleic acids. Since discovery of virus in 1892, describing a non-bacterial pathogen infecting tobacco plants, and the discovery of the tobacco mosaic virus by Martinus Beijerinck in 1898, about 5,000 virus species have been described in detail out of the millions of types of viruses in the environment (Koonin et al., 2006). Viruses are found in almost every ecosystem on earth and are the most numerous type of biological entity.

The social history of viruses describes the influence of viruses and viral infections on human history. Epidemics caused by viruses began when human behavior, particularly mobility and population density changed during the Neolithic period, around 12,000 years ago. This allowed viruses to spread rapidly and subsequently to become endemic. Viruses of plants and livestock also increased. As humans became dependent on agriculture and farming, diseases such as potyviruses of potatoes and rinderpest of cattle became prevalent with devastating consequences.

Smallpox and measles viruses are among the oldest that infect humans. Having evolved from viruses that infected other animals, they first appeared in humans in Europe and North Africa thousands of years ago. Europeans later carried these viruses to the New World during the time of the Spanish Conquests. Since indigenous people in Spanish conquered areas had no natural resistance to these viruses, millions of them died during epidemics. Influenza pandemics have been recorded since 1580, and since then they have occurred with increasing frequency in subsequent centuries. The pandemic of 1918–19, in which 40–50 million died in less than a year, was one of the most devastating pandemic in history (Rosenwald, 2020).

Every virus infection in the human body or any other living beings does not cause disease and kill the host. Propagation and survival of the virus depends on the host's survival and wellbeing. Many viral infections remain asymptomatic and continue to spread harmlessly. The recent outbreak of coronavirus (COVID-19) causes human disease but does not harm certain animals like bats and pangolins. Viruses do not only cause respiratory diseases but also they cause various types of cancers. For example, the Human Papilloma Virus (HPV) is known to cause cervical cancer in women and throat cancer in men and women, as well as several other cancers. Similarly, Epstein–Barr (EB) virus causes nasopharyngeal cancer and lymphoma.

Coronaviruses are a group of related viruses that cause diseases in mammals and birds. In humans, coronaviruses cause respiratory tract infections that can range from mild to lethal. Mild illnesses include some cases of the common cold (which has other possible causes, predominantly rhinoviruses), while more lethal varieties can cause SARS, MERS, and COVID-19.

SARS or Severe Acute Respiratory Syndrome was first discovered in Asia in February 2003. It probably came from wild animals. It was first reported in southern China. The outbreak lasted approximately six months. The disease spread to more than two dozen countries in North America, South America, Europe, and Asia before it stopped in July 2003. According to the World Health Organization (WHO), a total of 8,098 people worldwide became sick with SARS during the 2003 outbreak, and 774 of them died (source: CDC website). In the United States, only eight people had laboratory evidence of SARS-CoV infection.

Middle East Respiratory Syndrome (MERS) was seen in 2012 and 2013 in the Middle East, primarily in Saudi Arabia. MERS Cov was transmitted to humans from camels in the Arabian Peninsula. Infections were reported in 2,494 people. The death toll was high at 858 total deaths reported from MERS Cov (source: CDC website).

Most recently, new and severe respiratory illness was reported from the City of Wuhan, home of 11 million people in Hubei province of China. Respiratory illness was first reported in November of 2019. It was identified as a coronavirus disease in December and WHO was notified on December 31 about the spread of new severe respiratory illness. Chinese scientists sequenced the virus genome on January 2, which was released publicly on January 9. The World Health Organization (WHO) declared the 2019–20 coronavirus outbreak a Public Health Emergency of International Concern (PHEIC) on 30 January, 2020 and a pandemic on 11 March, 2020. The disease caused by this new virus was named as COVID-19 and virus was named as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Case fatality (risk of death after infection) varies by the country, generally reported as 2-10 %. However, the actual rate is difficult to calculate as we have a rapid rise in the number of infections and the asymptomatic infection rate is still unknown. It may not cause any symptoms in 25-50% of people who are infected but can still carry and transmit disease while they are asymptomatic (source: CDC website).

Rapid identification of disease and isolation is very difficult when the disease is transmitted by asymptomatic disease. Unlike Ebola where people infected were very sick, SARS Cov2 is asymptomatic in many who transmit disease. Complete social isolation of suspected infectious individuals is not possible as it is difficult to identify such individuals. While isolation is difficult, we have no disease-specific effective treatment yet to reduce the severity of disease and save lives. We also lack any remedies for post-exposure prophylaxis currently.

There are many research centers and pharmaceutical companies currently working very hard to make effective treatment and post-exposure prophylaxis. This likely will reduce the immediate disease burden and reduce the rate of infection. There are over 100 clinical trials on various drugs around the world. It will be months before we have a conclusive result of these trials.

Vaccines are the strongest defense of any viral disease. In modern history, we have eradicated smallpox from this world; Polio is nearly eradicated from the world now with effective vaccination. SARS Cov2 can be controlled well with the vaccine. There are dozens of different types of vaccines under clinical trials now. Results may take several months. Vaccine once confirmed it is safe and effective requires mass production and rapid distribution around the world for good and reliable control of this disease. Vaccination coverage of most current inhabitants of this earth can be challenging.

Ultimately, the reliable vaccine is the answer for COVID-19; however, many other things can done to reduce the casualties of the disease. The reduction of infection rates with social distancing is critically important. This will limit the exposure to the most vulnerable individuals in our society; slow down the infection to a level where everyone who needs medical care will have a bed in a hospital and if needed an ICU bed. Either a broad vaccination or spread of actual infection around the world can cause a herd immunity once it infects 40% or more population. Herd immunity is a form of indirect protection from infectious disease that occurs when a large percentage of a population becomes immune to an infection, whether through previous infections or vaccination, thereby stopping disease from spreading and providing a measure of protection for individuals who are not immune.

COVID-19 is a serious pandemic. It will not cause 50 million death as in the influenza pandemic of 1918 but still will cause substantial human casualties before the dust settles. The only best medicine now is to void infection by social distancing and personal hygiene. No medicine or food is known to boost immunity against COVID-19 so far. Until we have good control of the infection, let us stay away from other humans to help ourselves as well as other fellow human beings. (References can be provided on request).

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Unexpected Lessons

The exponential growth of new COVID-19 cases generated exponential change in our daily lives. In New York City, the situation quickly escalated from something to be monitored to an all-encompassing lockdown. Over one weekend, my medical school first dismissed us from our clinical duties for a few days, then our exam the next week was cancelled, and suddenly all our education became virtual for the foreseeable future. While this pandemic has been a unique ordeal, some of my past experiences have surprisingly influenced my perspective on the current situation.

Springtime in New York is especially sweet after the cold and dark winter. Now would be a time to see crowds flocking in the parks and other outdoor spots, but these areas are even emptier than they were on the coldest winter days. Oddly enough, I saw a similar emptiness in late spring of 2015, but this time on the streets of Pokhara. While visiting relatives on a trip to Nepal, I walked through the broad avenues, usually brightly lit and bustling with tourists from around the world, currently dark and colonized by local quarreling dogs. The earthquakes of that year brought seclusion to the usually vibrant city.

About a year later in the summer of 2016, I woke up in my parents' home in Louisiana and heard a strange dripping noise. After deciding that I was not dreaming, I looked out the window to see a pond of water nearly up to the glass. Overnight, a relentless summer storm had dumped an unbelievable amount of rain. However, our house had never been close to flooding so I convinced myself that this bizarre sight would drain away on its own. The rain continued and water began to seep inside from different areas of the house, but we believed that we could mop it up and throw it out and everything would be fine. After a few hours of scooping up the water, there was about an inch of flooding throughout the house. A few hours after that, I was wading through waist-high water while evacuating from our flooded home. As the situation got worse, normality's reference point kept moving and I kept finding myself doing things that even a little while ago would have been unimaginable.

When I first heard that NYC had a COVID-19 case, I felt sorry for the hospital that had to deal with it but did not think it would affect me much. The next week in the clinic I still occasionally shook patients' hands, but now reminded them to wash it afterward. A few days later, I stopped taking public transportation because the risks were getting too high. Soon after, social distancing goes into full effect. A few weeks ago it would have been unimaginable to think that we would reach a point where restaurants are take-out and delivery only, public transportation is reserved for essential workers, and birthday parties are virtual video hangouts. However, as unimaginable as it may have once seemed, it is our reality now.

Despite the spirit of unity and the idea of being "in this together" that follows these disasters, it never really does affect all members of society equally. I attend medical school in Manhattan, an urban island of mainly white-collar workers who are able to work from home and socially isolate from one another. Although now I wear a mask to the grocery store and must stand in line 6ft apart, I've never had any difficulty getting food. I have also occasionally volunteered in my school's affiliated hospital doing different non-patient-facing jobs. I've seen hospital administration shift focus from putting out fires early on in the outbreak, like procuring personal-protective equipment and ventilators, to now hunkering down to weather this storm. Basically, although the pandemic still maintains a strong and scary presence in Manhattan, most of the supplies and infrastructure are now in place (hopefully) to adequately endure this outbreak. However, this picture is not true for all of New York City. Hospitals and neighborhoods in other parts of the city, especially the Bronx and Queens, continue to face shortages and high rates of infection. Many residents of these areas are deemed essential workers and must physically go to work every day at grocery stores and in the hospital. Although the virus can affect anyone, it is increasingly clear that it will disproportionately affect those disadvantaged by race and class. The details are different, but the outline of this story holds true for other events like Nepal's earthquake or our Louisiana flooding. Everyone present was undoubtedly affected by these disasters, but in general those who have been historically marginalized end up facing the brunt of the effects.

Mr. Roshan Poudel
Student at NYU School of Medicine
Manhattan, New York, USA

Finding similarities between these superficially different events can be interesting, but is there any greater significance to it? I think there should be. On an individual level, reflecting on past experiences has helped me shape expectations and develop a loose framework to address my current situation. Obviously, it isn't perfect, but I at least feel like I have something. On a broader scale, there is always a talk of returning to "normal" after events like the one we are in. Unfortunately, "normal" usually means waiting for a disaster to happen before taking things seriously. Nepal decided it was time to start enforcing new building codes and earthquake safety measures after 2015, and my parents' area in Louisiana had to reassess its flood-diverting infrastructure after one storm destroyed thousands of homes. My hope is that we come away from this not only with more developed tactics to handle future disease outbreaks, but that we learn to take preparedness and prevention, as a philosophy for any crisis, much more seriously.

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Asta-Ja USA

500 University Ave #1410
Honolulu, HI, 96826
USA
Phone: (337)-739-3694
E-mail: info@astajausa.com
Website: www.astajausa.org