Asta-Ja USA Newsletter

December 2020, Volume 2, Issue 2

Message from the President

Greetings!

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

It is my great honor and privilege to present the third 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. This issue of the newsletter focusses on land resource. Several human civilizations in the past have crashed primarily due to land degradation and resulting food shortages, hunger and invasions. Food availability is still a major problem globally as about 690 million people currently go to bed each night hungry. Feeding global population which is expected to reach 9 billion by 2050 is a very challenging task. In the meantime, it is estimated that 25% of world's land is degraded. Therefore, implementation of sustainable land protection and development measures as well as land rehabilitation programs worldwide is necessary to maintain the food production capacity of the world.

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 63,044,066 people and claiming 1,464,724 lives globally by November 29, 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

Land Management for Agricultural Productivity

Land is one of the four production factors (i.e. land, labor, capital, and entrepreneurship) in agricultural production. Proper management and utilization of land is necessary for industrial growth and other economic activities including sustainable development of natural resources. To better manage the country's land resource, the Government of Nepal enacted its first Land Reform Act in 1956. The purpose of this act was to ensure proper utilization of land by enforcing the land ceiling—the act aimed at maintaining the difference between commercial agricultural land, industrial land, and residential areas. There were restrictions on land holdings and utilization based on agro-ecological zones of the country. This was the first attempt towards scientific management and the utilization of land resources in Nepal. Land survey, including land zoning, was the subsequent step taken by the Government following the enactment of the Land Reform Act. Land zoning is a common approach adopted by developed countries in Europe and North America to plan and implement proper agriculture considering land types, soil productivity, irrigation facilities, and climatic conditions. Soil surveys are necessary for implementing appropriate soil management practices and soil fertility improvement measures.

The land management situation in Nepal is currently in disarray. There is no clear classification of lands for various uses. There is no land zoning policy for agricultural production, residential uses, urban development, and other uses. Land utilization based on agro-ecological zones as envisioned by the 1956 Land Reform Act has never been implemented. As a result, residential areas are being developed in agriculturally most productive lands all over the country, from Terai to high-hills. Land fragmentation has resulted in such a point that it is extremely difficult to reverse the course and develop commercial agriculture in the foreseeable future. Furthermore, all these reckless land management activities have resulted in heavy soil erosion every year and lands have been severely degraded. In sloping lands, soil erosion is so massive that a single rain event sweeps away an inch of topsoil, which requires more than 1000 years to form. In order to protect lands from further degradation and enhance the sustainability of the land resource, it is critical to develop and implement 1) appropriate land-use policy including land zoning for agriculture, industrial, residential, public recreational, forest, and other uses, and 2) sustainable soil fertility management practices on agricultural and pasture lands.

Dr. Dilip R. Panthee
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While the decline in soil fertility is accelerated in agricultural lands, there is no single fertilizer factory in the country as of today. Farmers have to stand on mile-long ques every year for fertilizer purchases during crop growing seasons due to fertilizer shortages. It is of utmost importance for Nepal to design and implement immediately appropriate land management policies ensuring conservation of soils and soil fertility for enhanced agricultural productivity and the sustainability of natural resources.

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Soil Biological Health for Agricultural Productivity

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Soil contains living organisms and living soil is the Earth's most valuable ecosystem. Soil microorganisms such as bacteria, actinomycetes, and fungi play one of the most significant roles in sustaining the health of agricultural soil systems. Soil organisms are so small that they can be overlooked. Only recently, we have begun to understand and appreciate the effort of these helpful microorganisms. Moreover, in the past, soil microbiological science has focused upon the harmful or pathogenic microorganisms and this probably has distracted scientists away from beneficial soil microorganisms. There may be hundreds of millions to billions of microorganisms in a single gram of soil. For instance, bacteria are the most abundant microbes in soil with the population of more than one billion individuals per gram of soil. Actinomycetes and fungi are the next most numerous microorganisms in soil with more than ten thousand to one million per gram of soil.

There are various functions of soil microorganisms and some examples are described here. Bacteria and fungi decompose organic matter and help with supply as well as deliver nutrients directly back to the plant's root. Nitrogen-fixing bacteria form nodules on the roots of plants, take dinitrogen from air, and transform it to plant-available nitrogen. The plant also provides nutrients and protective home for bacteria. Just as there are beneficial bacteria, there are also beneficial fungi. Mycorrhizal fungi can form symbiotic associations with plant roots and are involved in the nutrient cycling processes especially in stressed environments (e.g., phosphorus and water deficient soils). These mycorrhizal fungi secrete a glue-like substance called glomalin that helps bind soil particles together. The zone of soil under the influence of roots a.k.a. the rhizosphere is a place where nutrients are plentiful, conditions are good and microorganisms flourish. The beneficial soil microorganisms help keep pathogenic soil fungi and bacteria away by generally consuming exudates right away, denying them to pathogens. When beneficial microorganisms assemble on root surfaces, they cover roots in protective living layers, crowding pathogens out of the rhizosphere.

Excessive and inappropriate use of certain chemicals, fertilizers, pesticides, fungicides, herbicides, heavy tillage, and different cropping system practices can destroy soil microbial communities. Changes in microbial community composition because of various disturbances may lead to changes in functional diversity of that community and ultimately, the overall soil quality. Maximizing living roots, crop diversity, use of cover crops, organic amendments, no-till farming, etc. can improve beneficial biological activity, soil structure, soil infiltration, water holding capacity, and soil organic matter. This can help build high functioning healthy soils, which require less water and synthetic fertilizers, thereby reducing farmer's expenses. It is our duty to educate and create awareness among farmers about the importance of soil biological health, which in turn is essential to agricultural productivity. We should always remember not to disturb our soil biology and healthy soil population should be promoted by agricultural practices for better human health.

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Soil Health Management for Sustainable Agriculture

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The Agriculture Development Strategy (2015-2035) of Nepal Government calls for a transformation in agriculture, from subsistence farming to commercial farming to achieve self-sufficiency in food production. Healthy soil is the foundation of sufficient and nutritious food production. Soils support agricultural production by regulating physical, chemical, and biogeochemical pathways of soil organic matter and nutrient cycling. Soils capable of functioning

well due to living organisms, balanced nutrients, and good physical condition are considered healthy soils. Maintaining soil health while improving crop production and environmental quality is an enormous challenge for countries, such as Nepal, facing challenges due to landscape variability, increasing population pressure, and climate change. It takes a long time to improve soil health and increase crop productivity. The best approach would be to adopt a soil health management system.

Soil Health management systems minimize soil disturbance, maximize soil cover, maximize continuous roots, and increase plant and animal diversity in agroecosystems. Nepal is an ecologically diverse country with enormous variability in land uses, climate, and agricultural practices. Besides, land use has been rapidly changing due to population growth and migration. While crop yields are greater in the Terai due to fertile soils, favorable climatic conditions, and availability of irrigation, Hills and Mountains provide niches for producing various fruits and vegetables. Development of region-specific soil health management strategies will increase agricultural production for feeding a growing population while sustaining soil health.

Novel soil and crop management practices such as conservation tillage systems, high residue farming, crop rotation, cropping system diversification through cover cropping, and integrated nutrient management have shown promises for improving soil health and sustaining crop production. Conservation tillage systems are recognized for their ability to increase soil organic matter storage, minimize greenhouse gas emissions, and reduce soil erosion. Conservation tillage increases crop residue inputs, reduces soil disturbance, and minimizes crop residue contact with soil microorganisms, leading to increased soil organic matter storage and other ecosystem services. In places like the mountains of Nepal, the conservation tillage is critical for crop production in areas with steep topography and high rate of soil erosion.

Soil health and fertility are usually rejuvenated by returning crop residue to the soil after crop harvest through nutrient cycling. Crop residue serves as carbon and nutrient inputs

to the soil. The effect of crop residue returned to the soil in maintaining soil quality and crop yield can be greater in conservation than conventional tillage systems. Reduced decomposition of crop residue accumulated at the soil surface helps accumulate soil organic matter. Soil organic matter level is usually greater with nonlegume residues than legume residues, which decomposes rapidly in the soil and supplies nutrients.

Crop rotation and diversification are other strategies for improving soil health and sustaining crop production. Including legumes in rotation with nonlegumes reduce nitrogen fertilizer use by supplying nitrogen from legume residue because of increased nitrogen fixation. Diversified crop rotations can improve nitrogen and water-use efficiency, crop nutrients uptake, and reduce fertilization rates compared to less diverse rotations or monocropping. We found an increase in soil pH under diversified cropping systems than under less diverse systems in the highly acidic soils of Nepal. Crop diversification and intensification also increase flexibility, productivity, and income stability to farmers. In recent years, cover cropping is considered for improving soil health while diversifying cropping systems. In addition to the benefits of crop rotation, cover crops can recycle nutrients that would otherwise be lost from the soil profile. The benefits of conservation systems and integrated nutrient management have been documented in Nepal and abroad. Integrated nutrient management systems that exploit organic and inorganic sources can also support soil health and agriculture sustainability.

The adoption of soil health management system relies on a new set of equipment and farming practices adjustments. Sustainable agricultural development remains a farfetched goal if the government does not incentivize soil health management systems or subsidize inputs and equipment for such practices. Ordinary farmers may not be able to afford the equipment needed for changes in farming practices. Recent initiatives on innovative farming practices, such as a climate-smart farming initiative, organic and sustainable production pockets, are promising approaches and should be further strengthened through emphasizing such practices in national policy and incentivizing the adoption of innovative practices in farming. Coordinated research on soil health management systems has not been started yet in Nepal. The development of government policies and programs based on region-specific research and farmers' engagement is pertinent for improving soil health and sustaining agriculture. Nepal Agriculture Research Council, Agriculture and Forestry University, and other agricultural research-based organizations can play a pivotal role in providing research-based data. Funding needs to be provided to the research institutions for establishing coordinated long-term farming system trials on various soil types and climatic regions of the country to support sustainable agriculture in Nepal.

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Asta-Ja USA would like to extend warm wishes on auspicious occasion of New Year 2021

Asta-Ja USA Family

How to Enhance the Sustainability of Cropping Systems by Reducing Nitrogen Fertilization Rates?

Dr. Upendra M. Sainju
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Nitrogen fertilization can enhance crop yields compared to no nitrogen fertilization, but an excessive application can reduce yields and increase the cost of fertilization without getting any benefits. Figure 1 shows that increased nitrogen fertilization rate increased spring wheat yield from 0 to 100 kg N ha^{-1}, but yield declined from 100 to 150 kg N ha^{-1} for continuous spring wheat and spring wheat-pea rotation. Increased nitrogen fertilization also reduced nitrogen-use efficiency for both rotations.

Some of the other problems with excessive nitrogen fertilization include degradation in soil and environmental quality. Increased nitrogen fertilization rate increases soil acidity or reduction in pH (Figure 2), which results in soil infertility due to reduced availability of nutrients. When soil pH goes below 5.5, crops hardly grow. At this stage, crops do not respond to additional nitrogen fertilization, resulting in a waste of fertilizers. Increased N fertilization also increases in the accumulation of nitrate-nitrogen (NO_3-N), especially at lower soil depths (Figure 3B). This nitrate-nitrogen is prone to losses due to leaching, thereby contaminating surface- and groundwater. Nitrate-nitrogen concentration greater than 10 parts per million (ppm) is a health hazard to humans and animals. Increased nitrogen fertilization rate can also increases global warming potential by enhancing nitrous oxide emissions, a potent greenhouse gas that contributes to global warming. Figure 4 shows that global warming potential remained at similar level from 0 to 100 kg N ha^{-1}, after which it increased linearly with increased nitrogen fertilization rate.

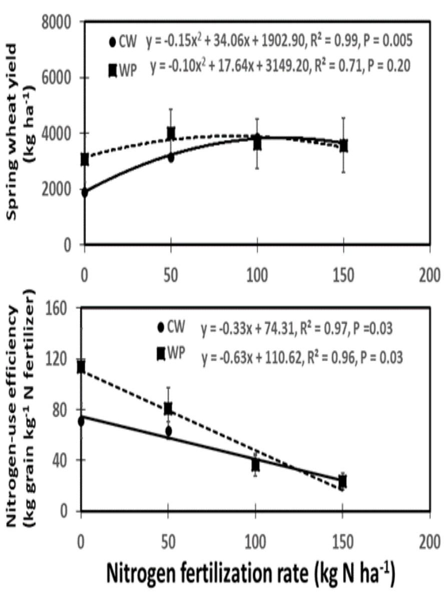

Fig. 1 Effect of nitrogen fertilization on spring wheat yield and nitrogen-use efficiency in continuous spring wheat (CW) and spring wheat-pea (WP) rotation.

So what can we do to sustain crop production, enhance soil health, and reduce environmental footprint? Several management practices can be employed to address these objectives by reducing nitrogen fertilization rates.

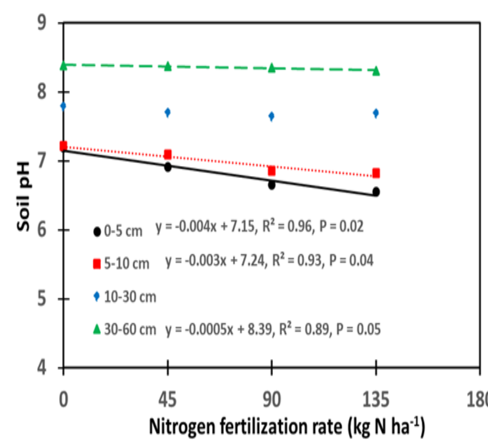

Fig. 2. Effect of nitrogen fertilization rate on soil pH at the 0-60 cm depth.

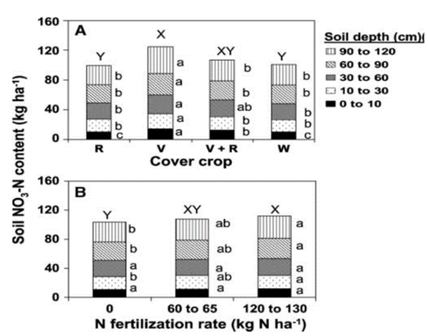

Fig. 3. Soil nitrate-nitrogen content at the 0-120 cm depth as affected by cover crop and nitrogen fertilization rate. Cover crops are R, rye; V, hairy vetch, V + R, hairy vetch + rye mixture, and W, winter weeds.

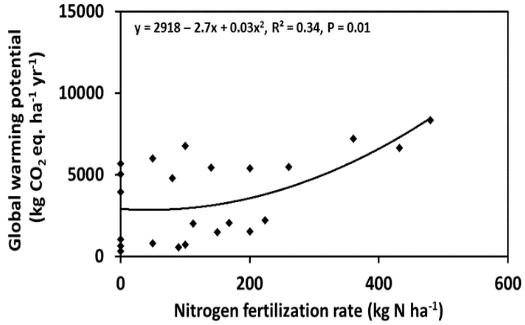

Fig. 4. Global warming potential as affected by nitrogen fertilization rate

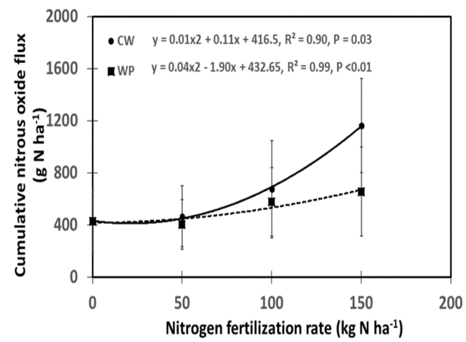

Fig. 5. Cumulative nitrous oxide flux as affected by crop rotation and nitrogen fertilization rate. CW, continuous spring wheat and WP, spring-wheat pea rotation.

Crop rotation: A rotation of legume and nonlegume crops can reduce nitrogen fertilization rate compared to continuous nonlegume monocropping because legumes fix nitrogen from the atmosphere, and their residue supply nitrogen to the succeeding nonlegume crops. Other benefits of crop rotation include increased water- and nitrogen-use efficiency and reduced infestation of weeds and pests. Figure 1 shows that spring wheat yield was greater with spring wheat-pea rotation than continuous spring wheat without nitrogen fertilization. When nitrogen fertilizer was applied, the benefit of increased wheat yield reduced with crop rotation, resulting in similar yields at 100-150 kg ha^{-1}.

Table 1. Mean soil pH at the 0-30 cm depth as affected by cropping system.

Cropping system[a]	Soil depth			
	0-5 cm	5-10 cm	10-30 cm	30-60 cm
NTCB/W	6.47c[b]	6.90	7.80	8.39
NTB/WP	7.16a	7.17	7.71	8.34
NTBWF	6.91ab	7.06	7.70	8.32
CTBWF	6.76bc	6.83	7.61	8.35

[a] Cropping systems are CTB/WF, conventional tillage spring barley/wheat-fallow; NTB/WF, no-tillage barley/spring wheat-fallow; NTB/WP, no-tillage barley/spring wheat-pea; and NTCB/W, no-tillage continuous barley/spring wheat. Barley was planted from 2006 to 2011 and spring wheat from 2012 to 2018.

[b] Numbers followed by different letters within a column in a set are significantly different at P = 0.05 by the least square means test.

Soil pH can also be increased with crop rotation compared to monocropping or crop-fallow rotation. Soil pH at 0-5 cm was greater with no-till barley/spring wheat-pea rotation than no-till continuous barley/spring wheat and conventional till barley/spring wheat-fallow (Table 1). Similarly, crop rotation can reduce nitrous oxide emissions compared to continuous monocropping. Cumulative nitrous oxide emissions was similar between spring wheat-pea rotation and continuous spring wheat at 0 and 50 kg N ha^{-1}, but was lower with spring wheat-pea rotation at higher nitrogen rates (Figure 5).

Cover cropping: Cover crops are grown during the fallow period to reduce soil erosion by increasing surface cover. Cover crops can enhance soil and environmental quality compared to no cover crop by increasing soil organic matter, aggregation, and microbial activity, reducing nitrogen leaching, and affecting greenhouse gas emissions. Nonlegume cover crops can increase soil organic matter and reduce nitrogen leaching by increasing biomass production compared to legumes or no cover crop. In contrast, legume cover crops can increase nitrogen supply, reduce nitrogen fertilization rates, and enhance succeeding crop yields compared to nonlegumes or no cover crop. A mixture of legume and nonlegume cover crops can provide benefits of either species alone.

A study conducted in Georgia, USA (Table 2) shows that cotton lint yield was greater with rye than hairy vetch, rye + hairy vetch mixture, and winter weeds (control). In contrast, sorghum yield was greater with rye + hairy vetch mixture than rye and winter weeds. While cotton lint yield is unresponsive to nitrogen fertilization, sorghum yield increased with increased nitrogen fertilization rate. The data shows that hairy vetch and hairy vetch + rye mixture can produce similar or greater cotton lint and sorghum grain yield than nitrogen fertilization rates of 60-65 and 120-130 kg N ha^{-1}.

Table 2. Effect of cover crop on cotton lint and sorghum yields

Cover crop	Nitrogen fertilization rate (kg N ha^{-1})	Cotton lint yield (kg ha^{-1})	Sorghum yield (kg ha^{-1})
Rye		879a[a]	2800bc
Hairy vetch		660b	3500ab
Rye + hairy vetch		706b	4000a
Winter weeds		699b	2800bc
	0	736	2800b
	60-65	783	3100b
	120-130	689	3700a

[a] Numbers followed by the same lowercase letter within a column among treatments in a set are not significantly different at $P \leq 0.05$.

Being a legume with nitrogen-fixing capacity, hairy vetch increased soil nitrate-nitrogen content to a depth of 120 cm compared to rye and winter weeds (Figure 6). The amount of nitrogen loss during the winter (from November to April) was also greater with hairy vetch than other cover crops (Table 3). A majority of this loss probably occurred through leaching in the groundwater in the winter when precipitation was greater than evapotranspiration. However, rye + hairy vetch mixture had the lowest nitrogen loss. Therefore, a mixture of legume and nonlegume cover crops can reduce nitrogen fertilization rate, sustain crop yields, and reduce nitrogen leaching compared to legume or nonlegume crops alone or no cover crop.

Table 3. Effect of cover crop on N loss from crop residue and soil N (NH_4-N + NO_3-N + organic N contents) at the 0-120 cm depth during the two winter seasons (from November 2000 to April 2001 and from November 2001 to April 2002) in central Georgia, USA.

Cover Crop[a]	Total crop residue and soil N[b]			Total crop residue and soil N[c]		
	Nov. 2000	Apr. 2001	Loss	Nov. 2001	Apr. 2002	Loss
	kg N ha^{-1}					
Rye	5057bc[d]	4888b	169b	4820b	4764b	56
Vetch	5455a	5235a	220a	5323a	5244a	79
Vetch/ rye	5249ab	5141a	108c	5222a	5182a	40
Weeds	4869c	4709b	160b	4725b	4649b	76

[a] Cover crops are rye, cereal rye; vetch, hairy vetch; vetch/ rye, hairy vetch and rye biculture; and weeds, winter weeds or no cover crop.
[b] Include soil NH_4-N + NO_3-N + organic N contents at 0-120 cm, and N returned to the soil from cotton biomass (stems + leaves) in November 2000 and cover crop biomass in April 2001.
[c] Include soil NH_4-N + NO_3-N + organic N contents at 0-120 cm, and N returned to the soil from sorghum biomass (stems + leaves) in November 2001 and cover crop biomass in April 2002.
[d] Numbers followed by the same letter within a column are not significantly different at $P \leq 0.05$.

Manure and compost applications: Applications of manure and compost can also reduce nitrogen fertilization rate by supplying N. However, the application of manure or compost alone is not enough to sustain crop yields. Table 4 shows reduced total biomass yield and N uptake of rye cover crop, cotton, and corn with poultry manure compared to inorganic N fertilizer (ammonium nitrate). A higher application rate of manure or compost might sustain crop yields, but most of the nitrogen from these amendments might not be available to crops due to the slow release of nitrogen. As a result,

Table 4. Effect of poultry litter and inorganic N fertilizer each applied at 100 kg N ha^{-1} on total biomass (stems + leaves) of rye cover crop, cotton, and corn and N uptake from 1997 to 2005 in Alabama, USA.

N source	Total crop biomass	Total N uptake
	Mg ha^{-1}	kg N ha^{-1}
Ammonium nitrate	133.3a[a]	1502a
Poultry litter	111.8b	1289b

[a] Numbers followed by the same letter within a column in a set are not significantly different at $P \leq 0.05$.

nitrogen released by these amendments during or after crop harvest is prone to leaching loss. Therefore, a mixture of manure or compost and reduced rate of nitrogen fertilization may be needed to sustain crop yields.

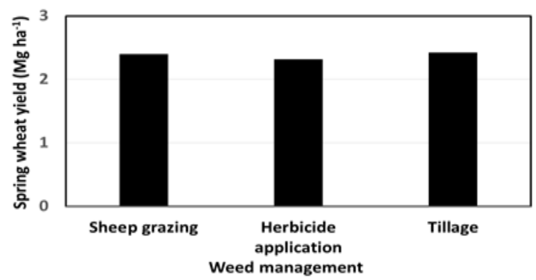

Fig. 6. Mean spring wheat yield from 2004 to 2008 as affected by weed management practice.

Integrated crop-livestock system: Rearing livestock provides milk, meat, wool, manure, and a draft for tilling the land for small landholders in developing countries, such as Nepal. Allowing livestock to graze on crop residue and weeds can reduce feed cost and control weeds, reducing the cost of herbicide application. Other benefits of animal grazing include soil organic matter enrichment and nutrient cycling. Livestock grazed on crop residue and weeds during the fallow period can also reduce nitrogen fertilization rates to crops. As part of nitrogen in crop residue and weeds is returned to the soil through urine and feces during grazing. A study conducted on the effect of sheep grazing for weed management in western Montana, USA showed that sheep grazing did not affect spring wheat yield compared to herbicide application and tillage for weed control (Figure 5). Therefore, an integrated crop-livestock system may be an option to reduce the nitrogen fertilization rate while sustaining crop yields.

Liming: Liming is done to neutralize soil acidity and increase nutrient availability to crops. As a result, it can reduce the nitrogen fertilization rate to crops. However, lime is bulky and expensive to apply. The effect of liming on neutralization of soil acidity is temporary in nature, and liming needs to be done every 2-3 years to maintain soil pH. The ideal method to reduce soil acidity is to reduce nitrogen fertilization rates by using improved management practices, such as legume-nonlegume crop rotation, cover cropping, manure and compost applications, and the integrated crop-livestock system as discussed above.

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Negative Emission Technologies

Climate change is one of the greatest challenges facing humankind today, which can have devastating impacts on every country, community, and person. To mitigate climate change and enhance economic growth, negative emissions technologies (NETs) can play a significant role. Becoming net negative emission, which is falling greenhouse gas emissions below zero, requires removal and permanent sequestration of greenhouse gas from the atmosphere more than it emits. Soil carbon sequestration, biochar application, and greenhouse gas mitigation as NETs can offer potentially important role in limiting global warming. Bioenergy with carbon capture and storage (BECCS), capture and permanent storage of carbon dioxide from processes where biomass is burned to generate energy, is becoming popular approach to achieve negative emissions in BECCS facilities operating around the world in addition to direct air capture.

Soil carbon sequestration - biological negative emission strategy - is one of main approaches for carbon dioxide removal and storage by fixing carbon in plants through photosynthesis and returning plant residue into the soil, which improves soil health. Soil carbon sequestration depends on the balance between carbon gain in soil through adoption of improved management practice and loss from soil through mineralization. Another management technique to reduce greenhouse gas emissions is to decrease the rate of nitrogen fertilization through adoption of best agricultural practices while sustaining crop yields. Excessive nitrogen fertilization increases nitrous oxide emissions, a potent greenhouse gas that is about 300 times more powerful than carbon dioxide in global warming potential.

Dr. Raj Kumar Shrestha
Columbus, Ohio, USA

The NETs suitable for Nepalese condition include: (1) enhancing carbon sink capacity by planting trees through afforestation and reforestation, (2) increasing soil carbon sequestration through agricultural practices such as no-till farming, cover cropping, manure and compost application, and integrated crop-livestock system, (3) increasing long-term soil carbon storage through biochar application, and (4) reducing greenhouse gas emissions managing agricultural practices. Sequestering carbon in the soil not only encourage negative emissions but also improves soil health and sustains crop yield. These NETs are important not only to avoid dangerous climate change but also to improve soil health and increase food production and economic growth.

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Do you know?

Asta-Ja USA is a 501(C)(3) Public Charity

Internal Revenue Service (IRS) has determined that Asta-Ja USA is exempt from federl income tax under Internal Revenue Code section 501(c)(3). The 501(c)(3) status is valid from the date of February 28, 2018, date of registration of Asta-Ja USA. IRS determined Asta-Ja USA as public charity. With this status, donors can deduct contributions made to Asta-Ja USA. **To donate to Asta-Ja USA**:

Write a check and give it to one of our board members or mail it directly to 500 University Ave #1410, Honolulu, HI 96826 Or using your credit

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Please note, you MUST always start at smile.amazon.com to support Asta-Ja

Black Soldier Fly, *Hermetia illucens:* A Multipurpose Insect

Dr. Raju Raj Pandey
California, USA

Black soldier fly (BSF; *Hermatia illucens*) is native of Neotropical region (South and Central America), which has become cosmopolitan in distribution. It is a medium-sized fly belonging to Family Stratiomyidae, Order Diptera)(Figure 1), which is slightly larger than a housefly. Due to its body coloration and longer antenna, it looks like a wasp (mimicry), but it is a harmless fly. Unlike house fly that can transmit various diseases by food contamination, neither BSF adult nor its maggot is a pest of any crop or vector of any disease, instead it helps to clean the environment. The adult fly does not even feed.

Figure 1. An adult black soldier fly.

In nature, the adult fly is attracted to the smell of decomposing organic waste. The adult fly lays clutches of eggs near decomposing organic materials. Newly hatched larvae known as maggot crawls to the food. White creamy maggots are legless and have very little developed chewing type mouthparts. It cannot chew the food but sucks the partly decomposed, liquid food. They keep eating and pooping. As maggots grow in size, they molt (five times). Fully grown maggot turns into a prepupal stage that is darker in color. Prepupae tend to crawl away from the food, looking for a drier area for pupation. The pupa is covered with a puparium. After transforming into an adult fly, it breaks the puparium to emerge into the environment (Figure 2).

Established in 2008, a South African company Agriprotein was probably the first undertaking to commercialize BSF production. Currently, there are multiple large companies involved in the commercialization of BSF. There are innumerable small companies and non-profit organizations promoting BSF cultivation and utilization. BSF has been reared around the globe in both commercial and backyard scale. Full-grown maggot or prepupae stage of the fly is at its peak from its nutritional value. High-quality protein constitutes about 40% of its body, followed by over 30% fat. The fly protein provides high-quality protein with all the essential amino acids needed.

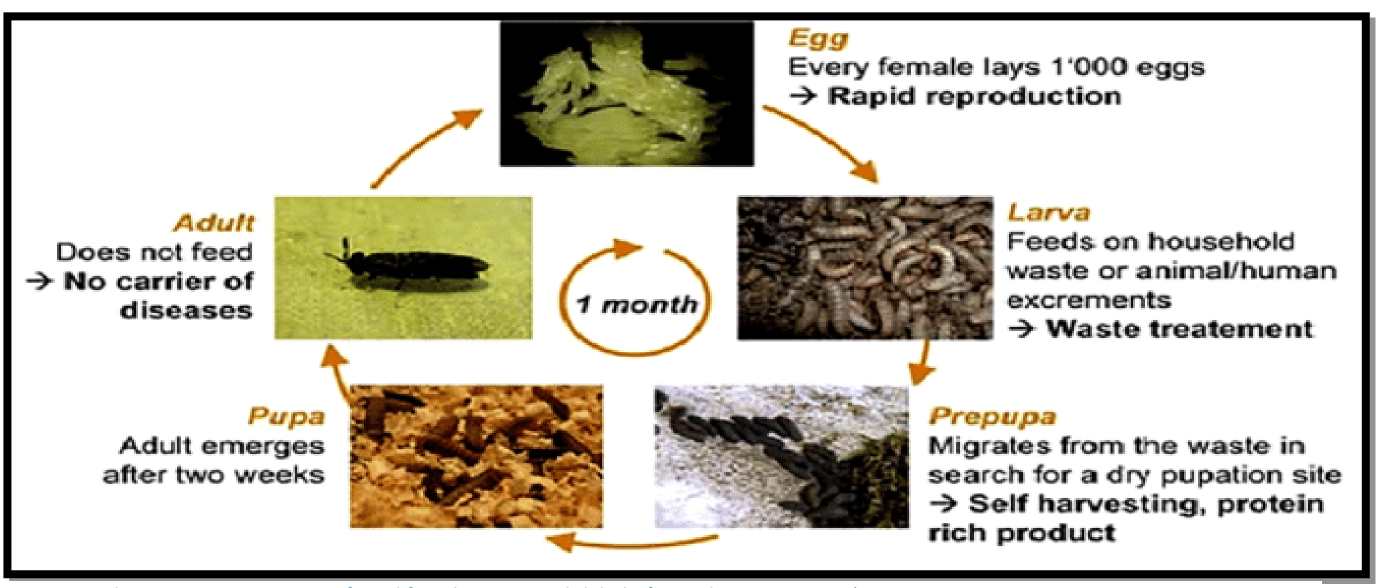

Figure 2. Schematic representation of BSF lifecycle. Source: Abdel-Shafya and Mansour 2018)

First and foremost, it can decompose a variety of organic waste matter (such as decomposable household waste, food waste such as fruits and vegetables, animal remains, animal excreta and so on) relatively quicker. Unlike conventional composting methods, which can take several months to over a year, or vermicomposting that takes about three months for organic matter decomposition, BSF can convert the organic waste in a relatively short time (less than a month). So, it can be employed for efficient urban waste management. This will reduce the amount of waste materials reaching the landfill sites. We have often heard about social tension between the waste management authorities and the local people living in the nearby landfill sites.

While decomposing the waste, the fly converts it into high quality animal protein that can be used as important component animal feed in poultry, aquaculture and piggery. At a household level, small BSF bin can be integrated with poultry coop. Fully grown maggot that tends to leave the bin are consumed by birds. Small scale fly factory can harvest the maggots and sell as fresh or dried maggot that can be fed to poultry or fish, or used as protein supplement in poultry feed. Poultry feed usually uses imported fishmeal or soybean as protein supplement. Therefore, production of BSF maggot locally using the waste product can help import substitution. Maggot fat can be used as biofuel and castings can be converted into organic fertilizers.

Major activities involved in BSF treatment facility can be divided into following five units:

1) BSF rearing unit: A consistent supply of high-quality fly egg and larvae is central to the success of the program. Temperature (22-28˚C), relative humidity (60-70%), and light intensity (equivalent to natural daylight) are necessary for mating and oviposition. The newly borne young maggots are usually fed on specialized food. Usually, 5-DOL (five-day-old larvae) are used for treating the waste materials. The adequate number of larvae are kept in the rearing unit to provide a consistent supply of breeding populations.

2) Waste receiving and pretreatment unit: Though BSF can feed on a variety of organic matter, they cannot feed on all types of urban waste. The organic waste (such as fruit, vegetables, animal remains and feces) that has high moisture (60-80%) suitable. These waste materials need to be free of hazardous and inorganic matter. Because BSF larvae cannot chew the food, it is necessary to convert them into finer particles. The food also needs high (60-90%) moisture content. So, the waste receiving and pretreatment unit should be equipped to separate unusable material and grind and pulverize the usable materials.

3) Waste treatment unit: once the waste materials are ready for use, they need to be treated with adequate BSF larvae. Temperature (24-30˚C) and moisture content (60-90%) in the waste material plays key role in the rate of maggot development and waste conversion.

4) BSF harvesting unit: Once the maggot reaches the last larval instar/prepupae stage, it needs to be harvested. The fly casting is usually removed by washing, and a clean maggot is collected for further processing.

5) BSF post-production processing unit: Full-grown larvae/prepupae are killed by drying or freezing. Then, fat and protein can be separated by further processing and distributed to various markets as demanded. The casting and residue can be further processed by composting or vermicomposting or by digesting through biogas plant to high-quality organic fertilizer.

Initiating a pilot program on utilizing BSF for organic waste management in cities like Kathmandu will provide practical application in solving waste management and reduce issues related to the landfill management. It will also provide raw protein that can be used in manufacturing poultry feed and help replace imported fish meal. Afterall, chicken never evolved eating fish, but insects. Based on the experiences of the program, it can be adapted, upscaled, and expanded to other cities. (References available on request.) ****

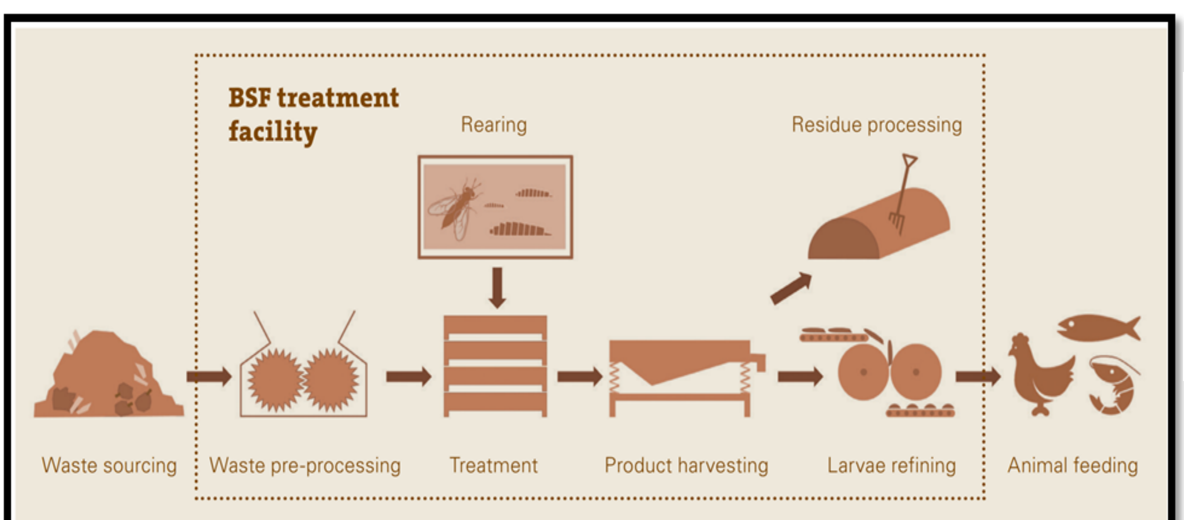

Figure 3. Steps in waste management involving BSF (Source: Dortmans et al 2017).

Issues and Perspectives on the Covid-19 and Nepal: An Introduction

Dr. Basu Sharma and Dr. Ambika P. Adhikari

Asta-Ja USA and Asta-Ja RDC published the book "Covid-19 Pandemic and Nepal: Issues and Perspectives" in December 2020. Edited by Basu Sharma and Ambika P. Adhikari, the book contains 12 papers by 17 authors. The 159-page book is a part of Asta-Ja's Occasional Book Series and addresses some of the key impacts of the ongoing Covid-19 pandemic in Nepal, and proposes some policy recommendations to mitigate those impacts. The book covers the areas of how agriculture, food production, employment, urban planning, economy, public health and research activities are impacted by the Covid-19 pandemic. The authors review the pandemic's impact in Nepal, analyze various scenarios brought about by the pandemics in these areas, and also suggest mitigation measures and policy recommendations.

In the papers, the authors have attempted to capture the micro and macro effects and analyze evolving future where things also can become better if appropriate policy and program interventions are carried out by the government and private sector. Recommendations coming out of these well-researched and well thought-through papers should add significantly to the public policy space in Nepal. Similarly, this book can also be a useful reference to those researchers, professionals and students, who are interested to review the impacts of the Covid-19 in Nepal, and explore possible solutions to help Nepal face the impacts of the pandemic.

The volume was published in a short time period to be of value to the individuals interested in reviewing the dynamics of the situation brought about by the Covid-19 in Nepal. For this purpose, the editors and publishers had to shrink the time period to collect, review and compile the papers to publish this document. The nature of the current pandemic is such that people will need to learn as they go forward. The editors and Asta-Ja believes that this volume will provide some good reference in this dynamic and fast-changing situation.

Asta-Ja occasional series publications are designed to discuss contemporary issues related to natural resources, agriculture, environment, infrastructure and planning that relate to economic development particularly in developing countries.

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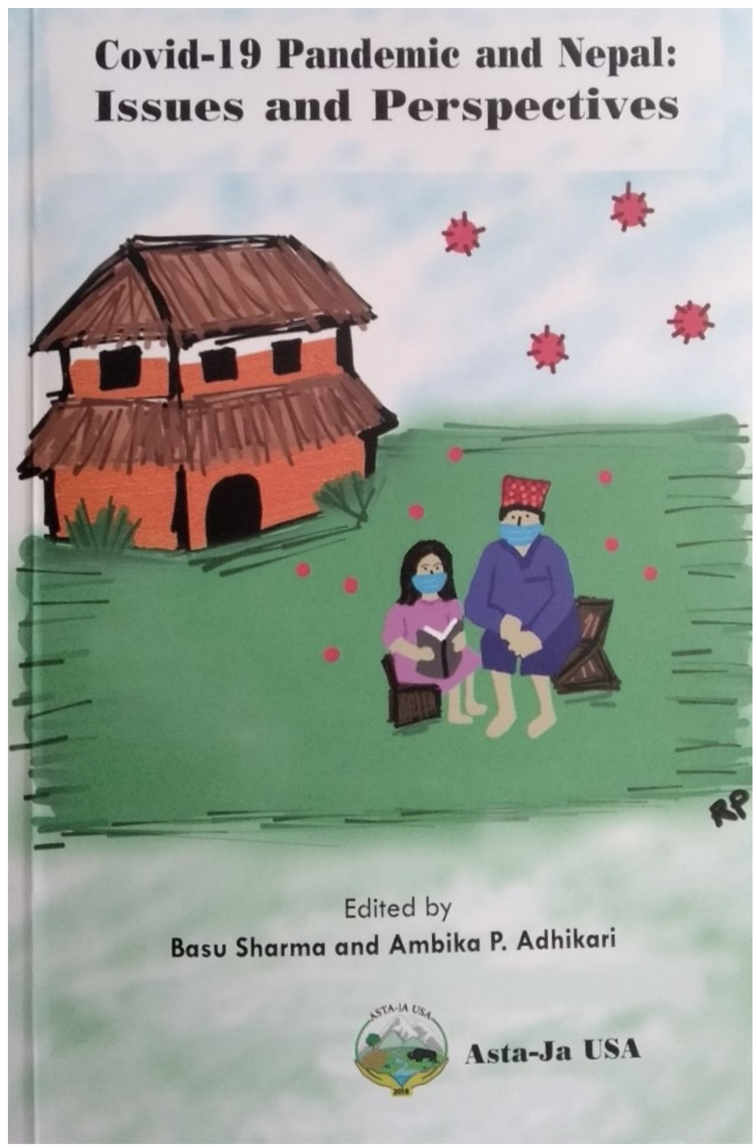

COVID –19 Relief Packages in Kathmandu, Nepal

Through the generous support of Asta-Ja members and other individuals, Asta-Ja USA in collaboration with Asta-Ja Research and Development Center (Asta-Ja RDC), was able to support 175 needy families with relief packages in Kathmandu Valley. Under the leadership of Mr. Bidur Koirala, a five-member (Mr. Hari Bhusal, Dr. Rasik Neupane, Mrs. Pratibha Pandit, and Mr. Bishnu Baral as members) Relief Work Committee was formed in Chandragiri Municipality, Kathmandu, on June 4, 2020. In coordination with the Mayor and the Deputy Mayor of Chandragiri Municipality and the Chairman of Ward no. 8 of the municipality, the Relief Work Committee developed a list of 85 needy families from Ward No. 8 and 15 families from ward no. 6, 12, and 14 for relief packages. The municipality officials and the local community members were highly appreciative of the work. Upon receiving the recipients list, a total amount of Rs. 150,000 was approved for the relief package. The committee was very enthusiastic and committed for the relief work. On June 10, 2020, the Relief Work Committee in Chandragiri Municipality along with the Deputy Mayor, the Chairman of Ward No.8, and members from respective Wards and other social activists from the communities successfully distributed the relief packages. A total of 85 families from Ward no. 8 and 15 families form other Wards received the relief packages, which consisted of one sack (30 Kg) of *Jira Masino* rice per family. There were also some community awareness activities with regard to COVID-19 pandemic. The event went smoothly without any conflicts and the committee members were very happy. The local communities highly appreciated the efforts of the Relief Work Committee and the entire team of Asta-Ja. Upon the successful completion of this event, another request was made from the community for supporting additional 25 families in the area who were badly hit by the pandemic. Accordingly, additional Rs.25,000 was approved for relief packages for these 25 families. A total of 125 families received relief packages in Chandragiri Municipality.

Mr. Pushpa Lal Moktan, President of Asta-Ja RDC, and his team identified another area in Kapan, Budhanilkantha Municipality in Kathmandu, where highly vulnerable migrant workers were in need for relief packages. These families were living in a very miserable condition after losing their jobs. With the support from local community volunteers, the elected officials from Ward no. 10

formed a 5-member Relief Work Committee, which was coordinated by Mr. Tek Bahadur Lama. Other members of the committee included Ms. Laxmi Khatri, Mr. Ram Prasad Dhungana, Ms. Pushpanjali Lama, and Ms. Uma Shrestha. The Relief Work Committee in Kapan prepared a list of 50 families for relief packages and submitted to Asta-Ja USA. A total amount of Rs.50,000 was approved for relief packages in the area. On June 13, 2020, each family on the list received Rs.1000 worth of *dal*, rice, salt and vegetable oil. Funding support from Asta-Ja USA for this relief work was highly appreciated by the local communities.

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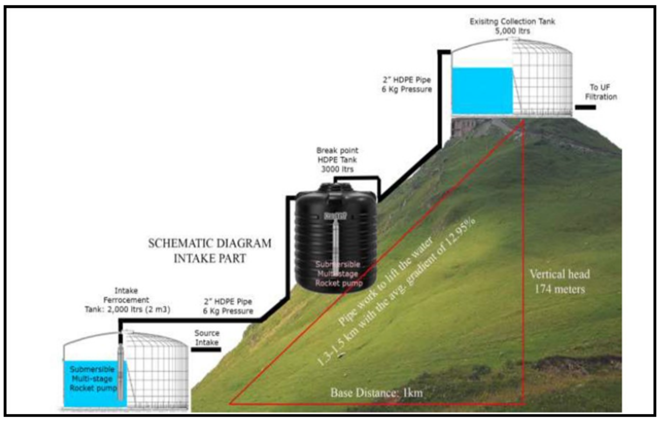
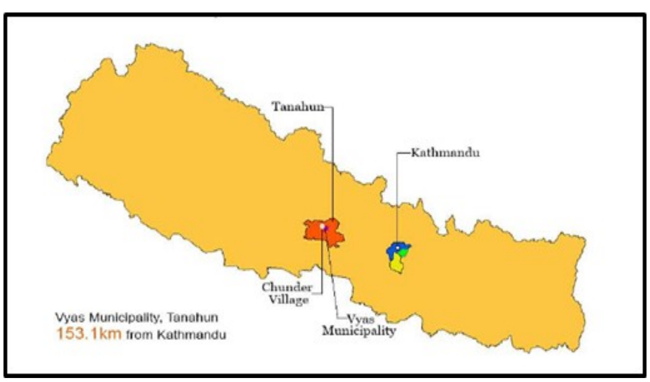
Chudher Drinking Water Project Begins

Dr. Arjun Aryal and Dr. Durga D. Poudel

In collaboration with Rotary International, Asta-Ja USA and Asta-Ja Research and Development Center (Asta-Ja RDC) worked closely with Rotary Club Damauli, Vyas Municipality, and Chudher Community in Vyas Municipality in Tanahu, Nepal, in developing a drinking water project. With the funding support from Rotary International, the construction work of the Chudher Drinking Water project has recently stared and it is planned to be completed by April 2021. The project consists of water lifting, treatment, disinfection, and distribution of drinking water to at least 120 households.



The Magar community in Chudher village is located at 2,206 ft above sea level, where women spend as much as five hours daily carrying water on their backs for their families. Chudher village sits on the hilltop which is about wo hours walking distance from Damauli Bazar in the north, overlooking the Himalayan range of Machhapuchhre, Annapurna and Lamjung Himal. Raising cattle, goats, pigs, and

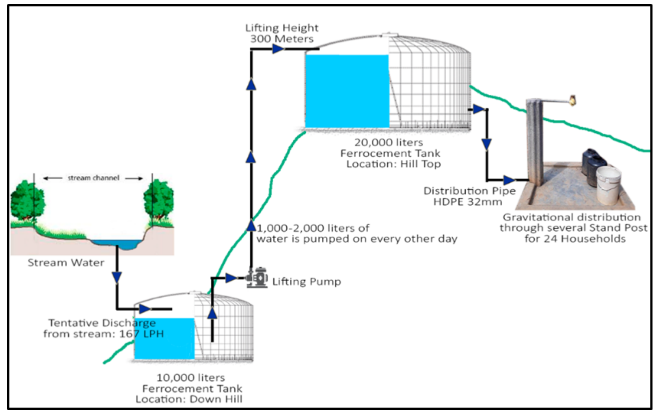


chickens for family consumption, farming on hillslope terraces, and working as agricultural laborers are some of the major activities practiced in the Magar community. While carrying drinking water for the family has always been a daunting task for women, the spring water sources drying up due to climate change in recent years has further aggravated this situation. This community also hosts an elementary school, where sufficient drinking water for school children has always been a challenge; they regularly go to nearby houses for drinking water. Asta-Ja RDC started meeting and discussion with Chudher community for drinking water supply in 2014.

Rotary International has funded $75,000 for the drinking water project. Rotary Club of Honolulu Sunset, Hawaii, USA, worked closely with Rotary Club of Damauli, Tanahu, in developing a proposal for submission to Rotary International. Rotary International has already wired funds to Rotary Club Damauli.

Rotary Club Damauli members are taking this project very enthusiastically and are participating voluntarily in many project activities including site visits, community discussions, signing MoUs, monetary handling, record keeping, participating in fortnightly virtual progress meeting that started two weeks ago, and establishing close relationship with Vyas Municipality Office and other stakeholders. Rotary Club Damauli and the Lucent Drop Nepal have signed MoU at the Mayor's office in Damauli on November 26, 2020. Project partners highly appreciate the continued support from Honorable Mayor Baikuntha Neupane, Vyas Municipality, Damauli, Tanahu, for the Chudher Drinking Water Project. Not too long ago, the members of the Rotary Club Damauli visited the source of Chuder Drinking Water project, the Pandherikhola, which is located at 1,391 ft above sea level, thus requiring a water-lift of 815 ft from the source to the village.

Drinking water from Padherikhola (a perennial stream) will be trapped and collected in a Ferro-cement tank with the capacity of 2,000 liters. The water overflowing from the tank will be channelized downstream. The Ferro-cement tank will be protected with a barbwire from vandalism and from cattle grazing in the surrounding areas. A submersible multi stage rocket pump will be used to lift the water from the tank into the Break point HDPE 3000-liter tank. A break point will be installed in the mid-point from the intake tank to the collection tank. A HDPE pipe with the diameter of 2" and the holding pressure of 6 Kg will be used to lift the water. The water thus lifted will be stored in an existing Ferro-cement collection tank with the total capacity of 5,000 liters. The panel boards for controlling the pumps will be installed close to the Collection tank uphill. The vertical head to lift the water from the intake to the existing collection tank is 174 meters and the total pipe work to lift the water is 1.35-1.5 km. The first attempt will be made to lift the water with more powerful pump to get water to the Uphill at Ferro-cement tank itself. Therefore, the Break point collection is just as optional at this stage. This design may have to be adjusted to some extent during project implementation.



In order to ensure maintenance and sustainability of the project for next five years, Asta-Ja USA is contributing $2,000.00 to Asta-Ja RDC, Kathmandu, Nepal. Asta-Ja RDC will plan and provide training on a Water, Sanitation, & Hygiene (WASH) component of the project at no cost basis. Once completed, the RC Damauli will hand over this project to Vyas Municipality, Damauli, Tanahu.

Rotary Club Damauli is also preparing to lead another Rotary International project next year that focuses on improving basic education by providing science laboratory equipment to two High Schools in Vyas Municipality, Tanahu, and by conducting adult science literacy training on environment and agriculture. About 30 Rotarians from Hawaii, USA, are expected to visit Damauli and nearby schools to participate in the project next year.

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ROTARY CLUB of DAMAULI
DAMAULI, NEPAL
Implementer
Funding Partner

ROTARY INTERNATIONAL
Funding Partner under
Global Grant

LUCENT DROP NEPAL
LALITPUR, NEPAL
Supplier
Technical Assistance

ASTA - JA for PROSPERITY

ASTA-JA USA and ASTA-JA RDC, COLLABORATING PARTNERS

Asta-Ja USA 2nd Annual General Meeting

Dr. Jiwnath Ghimire

The Second Annual General Meeting of the Asta-Ja USA took place virtually on August 2, 2020, from 8:00 to 9:30 PM EST USA. The meeting was organized and facilitated by President Dr. Durga D. Poudel. A total of 19 Board of Directors and Asta-Ja USA members attended the meeting. The meeting started with the welcome remarks from Dr. Poudel. He thanked all the outgoing Board of Directors, Executive Committee members, and other members for their continued support to Asta-Ja. He also presented the structure of the meeting.

Following Dr. Poudel, Dr. Ambika Adhikari shed some lights on the future of the Asta-Ja USA. He praised the passion and action-oriented works in the organization. He highlighted agriculture, self-help, and the environment as the organization's primary focus areas for its future activities. He also pointed out that there are many funding opportunities for the organization, and he proposed that the organization's focus areas be specific, small, local, and community-oriented.

The report from the President was circulated among members through email before the meeting. During the President's brief reporting, Dr. Poudel appreciated the work done by the different working committees, including the Policy Brief and Newsletter Committees. One of the significant milestones for the year 2020 was 501 C (3) status. Another featured project by Asta-Ja USA was the drinking water project with the Rotary Club Hawaii's funding support in coordination and collaboration with Damauli Rotary Club. Asta-Ja USA also participated in the NRN Conference, which attracted many interests from Nepal, the United States, and other parts of the world. He also mentioned that there were two newsletters and policy briefs published by the organization. Some other featured projects implemented by Asta-Ja USA included the Vegetable Production project and enhancing two schools' laboratory capacity in Tanahun, and COVID-19 relief work.

In the second part of his reporting, Dr. Poudel proposed four committees to carry out the organization's tasks. They were Organization, Marketing, and Networking Committee; Policy Advisory Council; Newsletter Committee; and Finance Committee; and asked members to join these committees voluntarily. He also highlighted membership enhancement tasks, Asta-Ja journal, post COVID-19 Resilient Nepal Convention, and extending collaboration with INGOs, GOs, and NGOs in Nepal for research and development projects.

Following President's report and proposal, the general discussion session started with a short-update by Dr. Arjun Aryal, General Secretary, and Dr. Prem Bhandari, Vice President, on lessons learned. Dr. Aryal emphasized that we need support from each other in the organization; he reminded everyone that treasure and talent are necessary to move the organization forward. Dr. Prem Bhandari added that Asta-Ja USA should enhance the resume by utilizing ICC members' profound knowledge, skills and networks.

Dr. Puru Shrestha further emphasized the role of networking, social, and professional connections for the organization's successful future. He reminded the participants that the international organizations have tremendous resources for Nepal and Asta-Ja USA is qualified to tap these resources. Dr. Prakash Neupane, MD, mentioned that the promotion of Nepalese herbs (*Jadibuti*) should be included in Asta-Ja USA's priority list. He also added that the organization should promote food security, cooperation, collaboration with other professional charitable organizations, and research projects. Dr. Tara Niraula mentioned that the members' expertise should be tapped for different focused areas of the organization. He reinforced that the organization should focus on small tasks but should become outcome-oriented. He also identified that networking with other professional and philanthropic organizations is the most significant opportunity ahead of Asta-Ja USA.

During discussion on the new frontiers of the organization, Dr. Krishna Paudel and Dr. Raju Pandey highlighted that marketing of food production and the facilitative role on export and impact should be the priorities ahead of the organization. Marketing of agricultural products, produce storage systems, training and capacity-building, waste management, alternative pesticides, and research were critical areas for the organization to consider for future endeavors. Dr. Kalpana Khanal added that the role of youth is instrumental. She mentioned that projects from Asta-Ja USA should involve graduate and undergraduate students and be assured that the organization gives back to communities and society in meaningful ways. Dr. Rupak Rauniar reminded that Asta-Ja USA should also focus on other opportunities besides agriculture in the international market.

During the open discussion session of the meeting, multiple members expressed their views. Dr. Tara Niraula proposed that the Finance Committee of the organization should be renamed to the Development Committee. Dr. Jiwnath Ghimire suggested that disaster preparedness, response, and recovery should be within the organization's scope because Nepal sits on one of the most active fault zones for earthquakes. Dr. Shyam Thapa re-emphasized the need for engaging students on environmental research and education such as vermicomposting. Dr. Prasansa Singh also supported the idea of promoting youth involvement in the organization. Dr. Kamala Neupane proposed that activities to promote health and hygiene at the grassroots levels should be the organization's focus.

Following the general discussion, the democratic process elected a 19-memebr Board of Directors, 2020-2022. The elected Board of Directors, 2020-2022 are:

	NAME	PHYSICAL ADDRESS
1	Dr. Ambika Adhikari	Arizona, USA
2	Dr. Arjun Aryal	Hawaii, USA
3	Mr. Bikas Sainju	California, USA
4	Dr. Deergha R. Adhikari	Louisiana, USA
5	Dr. Dilip Panthee	North Carolina, USA
6	Dr. Durga D. Poudel	Louisiana, USA
7	Dr. Jiwnath Ghimire	Hawaii, USA
8	Dr. Kalpana Khanal	Massachusetts, USA
9	Ms. Kamala Neupane, RN	Kansas, USA
10	Dr. Prakash Neupane, MD	Kansa, USA
11	Dr. Prasamsa Singh	Toronto, Canada
12	Dr. Prem Bhandari	Michigan, USA
13	Dr. Pushpa Pathak, MD	Texas, USA
14	Dr. Raju Pandey	California, USA
15	Dr. Rupak Rauniar	Texas, USA
16	Mr. Sahas Shrestha	Texas, USA
17	Mr. Shankar Gautam	Florida, USA
18	Dr. Shyam Thapa	Colorado, USA
19	Dr. Tara Niraula	New York, USA

The newly elected Board of Directors elected a 5-member Executive Committee, 2020-2022. The elected officials for 2020-2022 are as follows:

President	**Dr. Durga D. Poudel**
Vice-President	**Dr. Prem Bhandari**
General Secretary	**Dr. Arjun Aryal**
Joint-Secretary	**Dr. Kalpana Khanal**
Treasurer	**Ms. Kamala Neupane, RN**

The Election Commission for the AGM included following Asta-Ja USA Life Members:

Dr. Khusi R. Tiwari, Chief Election Commissioner
Dr. Puru Shrestha, Member
Dr. Basu Sharma, Member

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Asta-Ja USA

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