# The Belize Ag Report

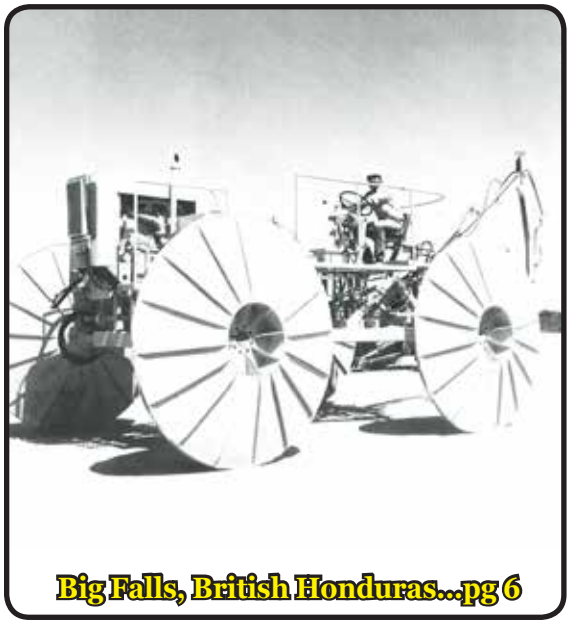
*Belize's most complete independent agricultural publication*







Rainfall
pg 12








**National Agriculture and Trade Show**
**27th, 28th & 29th May 2022**

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## Mission Statement:

***The Belize Ag Report is an independent semi-annual agriculture newsletter. Our purpose is to collect, edit and disseminate information useful to the Belizean producer, large or small. We invite opinions on issues, which are not necessarily our own. Belize Ag neither solicits nor accepts political ads.***

# From the Field

**Food Security**

Thank you Prime Minister Briceno for your emphasis for Belize to "grow more of what we eat and eat what we grow."

Achieving 'food security' requires local inputs necessary to grow that food: seeds, fertilizers, pesticides, water and knowledge. What's in our national seed banks? Reliance on imported seeds, (especially hybrid seeds, whose next generation of seeds cannot be reliably replanted) retains the cycle of dependence on importation. Cuba has an incredible array of tropical lowland heirloom seeds. Perhaps she would share? Honing regenerative farming skills is invaluable; protecting and restoring the vitality of our soil and water will protect ourselves.

How ironic that the 2 CARICOM countries denoted as LDCs (less developed countries), Belize and Guyana, are or were until recent world upheavals, the only CARICOM net exporters of food. Our exports are mainly unprocessed food crops, but over the years, we've slowly upped our consumption of imported processed foods. The typical USA diet is 57% processed foods. How has that worked out for them with their national health? Six out of ten have at least one chronic disorder and many suffer with compromised immune systems. No need for Belize to mimic that, or to begin eating bugs as recently approved by the EU or to switch to lab created 'meat' pushed by Bill Gates (Ag Briefs pg 33).

**A Clarification about our newsletter:**

Over the years since our 1st issue in 2009, people have asked us, "Who pays for the *Belize Ag Report*?" We operate as a DBA (doing business as) private company. In our acronym-laden world, **we refer to our newsletter as an NLE, "Not Lose Excessively" type of enterprise**. No writer, article contributor or service renderer (editing for example) has ever received payment from us. As typical for us NLE's, most or some of the printing and website costs are covered by ad sales revenue, the support of our advertisers. The Belize Ag Report is also distributed through our advertisers. Our team produces the paper mainly for 2 reasons: Folks tell us the newsletter is useful, and it's a privilege and a joy to interact with the people of Belize's ag sector. We thank you for your support: readers, writers, advertisers and others. The *Belize Ag Report* remains independent of any international or political funding.

Beth Roberson

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*We invite you to contact us with your letters to the editor, articles and suggestions for articles. Our mission is to serve the ag community.*

**"The power to question is the basis of all human progress."**
**Indira Ghandi**

# Letters to the Editor

Dear Editor,

It has been brought to our attention that very serious irrevocable damage to the beautiful landscape of Stann Creek is being put into place with the purchase of the 15,000 acre White Ridge Farm. The buyer, a multi-billion dollar company from the US, Vulcan Materials Company (VMC), plans to strip away the forest and soil, blast the limestone hills, crush the rocks and transport them to ships on a conveyer system near the largest Hawksbill sea turtle nesting beach and largest congregation of manatees in the western Caribbean. Furthermore, extensive dredging must be done to accommodate the anchorage and turning of 750 foot long ships. The water used and discarded during the mining operations will find its way into limestone conduits and show up in ground water used by farmers and households both local and distant. Dust from the operations will change the quality of air for miles around. The sound of constant heavy machinery will replace the serene sounds of the forest and the waves lapping on the beach.

It is of grave concern to us that allowing VMC to deforest the hills, remove the soil, contaminate the ground water and streams, change the water table and flow dynamics of the water in the region, disrupt the habitat of both wildlife and aquatic life in the area, endanger the Hawksbill sea turtles and manatees, in particular, is not compatible with long-term conservation of nature or Belize's natural resources. The disruption of the regional ecosystems, cultural traditions and upheaval of cultural values outweighs whatever promises VMC makes to improve the economy of the area. The extensive litigation VMC is

***Continues on page 32***

# Guest Editorial

## By Ed Boles, PhD Aquatic Ecologist

Representatives of Vulcan Materials Company (VMC), headquartered in Birmingham, Alabama, visited Belize on a fact-finding mission in December, 2019, and alerted many people of the Stann Creek District coastal area that the company intended to purchase the 6,000 hectare (15,000 acre) White Ridge Farm. They sent down a company team to conduct test borings of the karst and granite rock in early 2020. Their goal is to establish a foothold in Belize with a working aggregate mine and ship the mined materials from the karst hills of White Ridge Farm to southeastern United States. Their intention is to strip away the forest and soil, continually blast the limestone hills, breaking them apart, crushing rocks into graded sizes of aggregates required for roadbeds, fill, concrete and asphalt mixes, and other construction uses in the US where limestone deposits are now less available. The material is to be transported over land and into the inner channel off the coast just south of Gales Point by a massive conveyer bridge suspended above the land and water. The conveyer bridge will be transporting crushed and sorted aggregates to Panamax self-loading ships waiting at anchor in the deeper waters of the inner channel. Dredging will be required to accommodate the 228 meters (748 ft., or longer) vessels with 13.5 to 14 m (44 to 46 ft.) draft, and the area will need to be large and deep enough to turn these vessels.

The scale of the project and the removal of karst features/ aquifers is not compatible with the sustainable use of this area that conservation NGOs and residents have been envisioning and striving toward for three decades. The VMC mission is "to provide quality products and services which consistently meet our customers' expectations; to be responsible stewards with respect to the safety and environmental impact of our operations and products; and to earn superior returns for our shareholders." The first guiding principle listed on the VMC website is integrity, stating "We will work constantly to earn the respect and trust of all parties we interact with by acting fairly and honorably. We will observe high ethical standards and obey all laws and regulations."

Areas within the Gulf Coast and Eastern Seaboard states have few locally available aggregate resources remaining. These areas are supplied from quarries in the Yucatan Peninsula of Mexico just south of Playa del Carmen, shipped to US ports by the VMC fleet of Panamax-class, self-unloading ships, and moved by barge and rail to market locations. Public protests against the mine continues, as do protests and court cases in many areas of the US where VMC operates. **Now this multi-billion-dollar company has set sights on the limestone deposits in Belize right next to the largest Hawksbill sea turtle nesting beach and largest congregation of manatees in the western Caribbean.**

Scraping away the forest and soil from a karst deposit imposes many impacts, including increasing the rate of stormwater runoff and erosion of the disturbed landscape and heavy sediment loads entering streams and the river. Karst water supplies are vulnerable to unwise land use activities that change the vegetation and geology of an area and can impact water users located at large distances from the water source. Deforestation and soil removal reduces the infiltration of rainwater into the ground that ultimately recharges aquifers. Unfiltered water from mining sites that enters groundwater resources from the mining pit or sink holes can greatly reduce groundwater quality. Ground vibrations created by rock blasting and heavy equipment can loosen small particles within fractured rock and conduits, increasing turbidity within groundwater, which can show up in people's wells. Given the larger caverns and conduits within karst aquifers, groundwater moves much faster than occurs in other rock types, and any pollutants and pathogens in contaminated water are transported long distances compared to other aquifer forming rocks.

Disruption of a groundwater conduit by mining activities can change the flow path of a large volume of groundwater, causing water to be redirected to discharge outlets in other locations, drying up damaged streams. Mine pit dewatering, the water being pumped out so mining can continue, can change local groundwater hydrology by lowering the water table, creating a cone of depression, similar to the effects of a large well on surrounding groundwater. Water bodies, springs, and wells within the cone of depression created by a mine pit penetrating the saturated zone can reduce inflow and may go dry due to the changed flow of groundwater. Many sinkholes often occur within the cone of depression caused by a limestone pit mine.

**The continual blasting and drilling and the continual movement of materials over the conveyer bridge will create patterns of vibrations that may affect manatee, sea turtles, and other wildlife in the area.** Besides the impact on wildlife, these sounds will become a continual set of noises within the landscape, particularly those areas within a few miles of the mine. Ultimately, we are not sure just what the impact will be on the wildlife within the surrounding land and waters…until it starts to happen.

The United States does not produce enough limestone to satisfy its consumption rate, importing mainly from Canada, Mexico, and China. This explains the strong interest in setting up the first of what could become several mines in Belize. Many limestone sites in the US are off limits to mining, having been developed into housing complexes, parks, protected areas, important aquifers, and other uses. **It is also now harder to establish mines in new places within the United States because people do not want quarries near their residences. VMC has been in litigation with many communities affected by their mining activities spread around the United States because of the impacts given above and more.**

Because of this increasing resistance to mining in the US, **those impacts, including damage to groundwater resources, air quality reduction from dusts, noise pollution from blasting and heavy equipment, habitat loss, disruption of scenic vistas, and the overall degradation of the landscape are being exported to other countries, out of sight and out of mind to the many people who will be traveling over road beds made from the pulverized karst hills of Belize.**

***Editor's Note: Dr. Boles, adjunct faculty member of Galen University, is known all over Belize for his expertise in conservation. He has spent over 30 years conducting rapid ecological assessments of watersheds and wetlands; promoting protection and restoration of steep slope, riparian, and wetland forests as critical components of watershed management; helping standardize water and watershed assessment methodologies and protocols; encouraging environmental research projects that inform conservation initiatives; and involving Belizean and international youth in these activities.***

# Big Falls Ranch: Rice Production (Part 2)

## By Feucht/Roberson


Albert & Betty Bevis

As described in part 1 of this article The Bevis family, who leased 11,000 acres of land along the Belize River in 1964, chose rice as the most viable commercial cash crop to grow while developing a cattle ranching operation. The two main crops at that time in Belize (British Honduras) were citrus in the south and sugar cane in the north. The rest of the country, including Big Falls, was relatively undeveloped with no infrastructure. Tracked vehicles were used to clear the land at Big Falls. The first Caterpillar D6 used after the Bevises arrived was followed by a second one a few years later. Some of the heavy equipment was transported the 75 miles on the meandering Belize River by barge or the 40 miles by truck to Mile 26 ½ where it was unloaded and driven into the bush. After relying on river transportation the Bevises built the 10 mile road from Big Falls to Mile 26 1/2 to solve the logistics of transporting equipment in and harvests out of Big Falls. (The Western Highway was paved only from Belize City to Hattieville at that time.) Even after that the ranch was sometimes isolated, as in late 1965 when the Belize River rose to a record high; the only access was by boat or air. The Bevises crowned the airstrip they built to allow drainage; so it was useable even in the rainy season. When a new Caterpillar arrived early in 1966 and Chuck was able to drive it from the highway to the ranch, Albert wrote to his mother: *"This contrasts with two years ago when we took 14 hours to drive the tractor and other tools in over a new road in April of that year."*

The Bevises experimented with 12 different varieties of rice and engaged specialists to help with research in their new endeavor of farming in the tropics. They used their new John Deere 105 Combine followed by a trailer for the first rice crop harvest in February 1965. They had planted the rice in the fall (a first for Belize) so they could harvest it during the dry season using mechanized equipment (a first for Belize) instead of by hand in the paddies. That first crop, grown on only 50 acres (20 ha.) with 45 lbs. of nitrogen per acre, was 3000 lbs., reported to be the best yield of any rice farmer in the country at that time. They had constructed a 77 x 27 foot pole building but the first crop was an overflow for their makeshift storage bin. They borrowed a dryer from the government for the first harvest but devised their own system of "hardware cloth" on a false floor using hot air until they built their own mill in 1969. For the first crop they devised an auger using tractor power to fill the 100 pound burlap sacks. They constructed a conveyer to load the sacks on to a barge in the Belize River to transport them to the marketing board in Belize City. The marketing board was the focal point for rice production at that time. Besides providing rice drying and processing services it controlled the price and distribution of the rice.

The Bevis team started out with only one crop of rice per year but after they cleared more land and built an irrigation system they expanded to 2 crops a year. The first water for irrigation was pumped to Big Falls through pipes from the Belize River into a canal in October 1966. The pumping station is still there today. A bridge then had to be constructed over the canal for the field equipment. Every step of the development of Big Falls was first a hurdle and then a solution solved by the Bevis team. Albert wrote to his mother in 1966; "It has been hard work but enjoyable." After trips to El Salvador and California to investigate the latest rice growing techniques the Bevis team learned how to grow two crops per year. They bought 12 ½ tons of rice seed from a grower in El Salvador. With the help of a civil engineer they designed an irrigation and draining system. It took three years to design and build contours with flood gates to control water for irrigation. The soil was tilled under about 10 cm. of water using a tractor equipped with oversized tires; the seed was planted using an airplane. Then the water was drained from the fields; when the rice was about a foot high the water was pumped back in. It took 90 days from seeding to harvest. The water was once again drained from the field about 10 days before harvest to harden the soil for mechanized equipment and speed the drying and ripening of the grain. By the early 1970's they had constructed over 10 miles (16.2 km.) of canals, a pumping capacity of 4,500 gallons (17,100 litres) per minute, and some 20 miles (32.4 km.) of drainage ditches.

As the operation expanded more employees were hired; the first employees were local people who helped clear and develop the land. Chuck described them as reliable and dependable; he said he learned a lot from them. By the time the all-weather road into the ranch was constructed there were over 100 workers. Novelo's buses brought employees in from Cayo on Mondays and took them back home on Fridays. The kitchen crew obtained supplies from the Mennonite Center to feed them during their stay at the ranch.

At first heavy tractors were used in the flooded rice paddies; mud didn't stick to the tires because the water cleaned them off. Then they used a special tractor for muddy fields; the tires were specially made for mud: much larger and flatter than the typical field tractor; they looked like huge disks *(cover photo)*. As the Big Falls Ranch expanded so did their fleet of big equipment. Some of it was shipped in boxes and assembled at the ranch. By 1971 the magazine *Agricultura de las Amèrica* listed their fleet as 6 Caterpillar tractors, 13 Case tractors, a John Deere combine (threshing/harvesting), and 4 groups of Caterpillar generators. Their rice milling capacity was 8 MT per hour; the mill was operational 12 hours a day, sometimes up to 24 hours, during harvest. As equipment increases so does maintenance; it wasn't long before Bevises constructed an equipment maintenance garage. However, there was definitely a shortage of equipment repair knowledge; most of that task was left to Chuck. In May, 1966, his mother wrote to the family that the tractors were being run 24 hours a day to take advantage of the dry season which lasted less than a month that year. Chuck could not get a good night's sleep with interruptions from workers who needed help with repairs or service.

Key to the expansion of the ranch was a new partnership with Kern County Land Co. Albert wrote to his mother about the joint venture following his 3 month trip to the US: "This gives us the stability and money we needed to complete the development of the ranch." The pilot project was 500 acres (200 ha), which yielded over a million pounds of top quality rice in 1971. The expansion plan was 4,000 acres (1600 ha.) per year with a target of 32,000 (12,800 ha.). Storage capacity expanded to 6 silos each of which could store a quarter of a million pounds. Not only were they growing rice and beans, but also raising cattle and other farm animals.

*A newspaper article from December, 1969 summarized the country's rice harvest as follows:*

*"Seasonal purchases of rice by the Marketing Board to the end of November amounted to 3,943,011 pounds:*
*Toledo Farmers – 2,486,549 lbs.*
*Mafredi Scheme – 507,882 lbs.*
*Columbia Farmers Co-op – 58,871 lbs.*
*Mopan Farmers Co-op – 69,813 lbs.*
*Big Falls Ranch – 624,407 lbs.*
*R.M. Jacobs – 195,489 lbs.*

*At Big Falls Ranch over 270 acres ((108 ha.) have been planted and further plantings up to 600 acres (240 ha.) are in train. A mill has been set up and is in production and Big Falls rice is now being sold on the market. All future rice production from Big Falls is expected to be milled and sold by Big Falls Ranch Ltd. and will not therefore be handled by the Marketing Board."*

The Big Falls Ranch started out as a Bevis family operation; but after expansion and over US$1.2 M investment the Bevis team decided it was time to negotiate concessions with the government of Belize. According to *The New Belize* magazine in 1971, Albert Bevis said he wanted 3 things: (1) a crop that would grow well in this climate, (2) a crop that could be mass-produced by modern farming technology and could be stored for long periods without spoiling, and (3) a good market abroad. Backed by Barclays Bank in Belize City, he sought two large groups who invest in projects of this type: The Commonwealth Development Finance Company Ltd. (CDFC) and Adela Investment Company, a multinational private investment banking company whose charter limits financial support to Latin American enterprises. The purpose of both of these financial institutions was to foster economic development.

In May 1971 in the office of the minister of trade and industry a historic agreement was signed by Minister A.A. Hunter (for the government) and Albert Bevis for Big Falls Ranch Ltd. Under the agreement the ranch would supply the domestic market with rice from their own production of the same high quality acceptable to international markets but "only to the extent that other national farmers cannot meet the effective domestic requirements or as otherwise agreed with Government. Any industry which comes into the country which does not redound to the benefit of our national Belizean farmers would not be in keeping with our national aspirations and Big Falls Ranch Ltd. has agreed to provide planting material, technical assistance and information for growing and harvesting techniques of a standard similar to that used by itself in its own production and this at an agreed price to national farmers." The ranch agreed to purchase and mill rice of its same quality from other farmers and provide opportunity for locals to be hired in all phases of ranch operations. The agreement was in keeping with the Bevis family's goals. They wanted as many as possible Belizeans to participate in the massive programme they and the investors were advancing. Albert was quoted as saying, "…I feel an almost religious fervor when I get up to work every morning and I realize that the job my family and I are undertaking here will have such a beneficial and widespread impact on the whole economy of this country which I have adopted. We consider it a privilege to be able to work in this very stable country."

Just as the ranch enterprise was heading for sustained success in the mid 1970's the dream faded. Several main factors contributed to the demise of Big Falls Ltd.. First and most importantly, world prices and a fuel shortage competed with rising interest rates. The government of Belize, who controlled the local prices, lowered the price on the local market as well. By agreement with the government of Belize, Big Falls was exporting 40% of its production and selling 60% of its production on the local market at the price set by the government. The combination had been economically feasible for Big Falls originally. However the inflationary factors made the original calculations of cost impossible to achieve. During this pre-independence era (independence came in 1981), patriotism and nationalism swelled, and relationships between the government and foreign companies chilled, even with those businesses already well established and holding meritorious relationships with the people and the government. An ambience of hesitation was in the air; Belizeans in the public and private sectors pondered if the country would be better off to slow industrial development until native Belizeans could move the nation forward. USA giant Daniel K. Ludwig, described in 1979 by Time magazine, as "the richest man in the hemisphere" approached the Belize government regarding setting up shop in Belize at this time. Ludwig's plans for Belize were denied. He moved on to Brazil, where he operated for several decades. Another factor was the financial failure of Adela Investment Co.; it had overextended its financial support to failing enterprises in Central America. The final straw was the change in management personnel of the enterprise; fiscally conservative and agriculturally experienced personnel were replaced with managers whose management style was incompatible with that of the original team. The original team left and Big Falls' productivity began to slide.

The finest days of the Bevis family enterprise holds a legendary place in Belize's agricultural history. They provided a sterling example of development benefiting the people of Belize while showcasing Belize's tremendous agricultural potential to the world.

**Para cultivar arroz** gananciosamente es indispensable nivelar bien el terreno. Sólo así puede lograrse absoluta uniformidad en la inundación del arrozal. Se utiliza una niveladora Landplane de 4.80 m x 27 m a remolque de un tractor D5 que trabaja a 5.6-6.4 km.p.h. en 3a. y 4a. velocidades.

Albert and his wife, Betty, and son, Jim, resettled in the US. Elder son, Chuck, and wife, Carol, moved to Brazil where Chuck's Belizean experience was valued in Daniel Ludwig's operation. Jim eventually returned to Belize with his wife, Marguerite; they acquired and expanded Mountain Equestrian Trails, which their family still operates in the Pine Ridge area.

# Field Survey: Collection and Analysis of Data on Pesticide Poisoning Incidents among Farmers in Belize 2021

**By Dr. Sherlene Enriquez-Savery & Mr. Sean Sebastian**

In June 2020, the University of Belize (UB) administered a field survey, *Collection and Analysis of Data on Pesticide Poisoning Incidents among Farmers in Belize*. The field survey was a partnership between UB and the Food and Agriculture Organization of the United Nations (FAO). The Rotterdam Convention of the United Nations, to which Belize is a Party, has a core objective of mitigating the adverse effects of pesticides on human health. This includes actions to reduce poisoning incidents due to severely hazardous pesticides formulations. The focus of the survey was only on short-term health effects of reported poisoning incidents; no long-term health effects were considered.

The survey, which was administered to a total of 150 farmers and farm workers (FFW), was conducted by UB students majoring in agriculture. The students gained a wealth of experience as they talked face-to-face with farmers and farm workers. Most of the FFW were male: 94%. The age distribution was mostly 21-40: 54%; ages 41–60: 28.7%; over 60: 10% and under age 21: 7.3%.

The survey revealed that the farmers interviewed had, indeed, experienced mild to severe reactions from pesticide usage in the field. According to reported symptoms, doctors' diagnoses and hospital records, the most severe reactions included excessive stomach pain, vomiting, dizziness, headache, slight damage to respiratory system, eye irritation, skin burning sensation and rash. As bad as these reactions were it is noteworthy that from the list of pesticides reported by the farmers, none of them that made the top 10 list were from the Class I toxicity (most toxic pesticides) group. The pesticides from the Class I toxicity group involved in the incidents were: Vydate 24 SL, Lannate 21.6 SL, Lannate 90 SP, and Lash 90 SP and were ranked 17th, 19th, 20th, and 26th, respectively.

It was found that most (54.9%) FFW either did not know (7.0%) or were not sure (47.9%) whether the 26 pesticides that belong to the Class I group and those pesticides in incidents that caused "extremely severe / very serious" symptoms used on the farm were a health problem. (The top three pesticides that FFW were most knowledgeable of in terms of toxicity were Gramoxone 20 SL, 2,4-D Amine 60 SL and Lannate 21 with scores of 80.0%, 78.5%, and 69.2% respectively.) This tells us that the majority of FFW still do not know enough of the health hazards of the pesticides used on their farms. However, the data also indicates that FFW respondents are not frequently using pesticides in the Class I Toxicity group, which is a good farming practice for safety reasons.

A subsequent review of the pesticides was done to identify the reported pesticides' active ingredients. Some 27 active ingredients

***Continues on page 34***

# Review of 2020 & 2021 Pesticides Imports Data

Records of imports data for this period indicate that there was an increase in importations of pesticides and its related substances compared to previous years. Even though the pandemic was hitting Belize, the agriculture sector did not collapse. The reasons for an increase in importation can be attributed to the following 1. There was an increase in agricultural production, particularly grains. 2. Favourable climatic conditions prevailed – less drought. 3. More Belizeans went back into farming after the tourism industry collapsed. As shown below, total imports for 2021 decreased by 15.86 % from 2020 imports.

Note: All quantities are recorded in metric tons of active ingredient (AI)

| Year | Total AI (MT) |
|---|---|
| 2020 | 1,334.69 |
| 2021 | 1,123.03 |

**By classification** and its related substances, imports records show that herbicides, fungicides and insecticides amounted to 60 % of total imports; the other 40% are comprised of adjuvants, seed treatment, domestic use and wood preservative. Records for 2021 show herbicides decreased 33.12 % and insecticides decreased 18.9% compared to 2020, while fungicide recorded an increase of 20.09 % from previous year.

| Total AI (MT) | 2020 | 2021 |
|---|---|---|
| Herbicide | 558.72 | 373.63 |
| Fungicide | 200.64 | 240.95 |
| Insecticide | 54.161 | 43.928 |
| Others | 521.16 | 464.52 |

**By activity**, records indicate that pesticides classified for agricultural use amounts to approximately 98 % of total imports while the other 2% are comprised of pesticides classified for public health purposes.

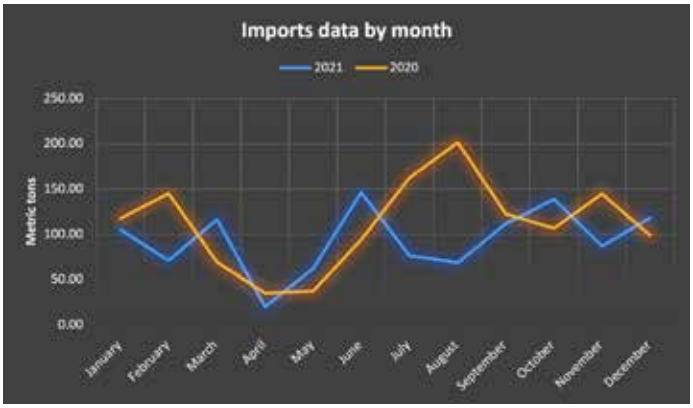
| Total AI (MT) | 2020 | 2021 |
|---|---|---|
| Agricultural Use | 1,318.58 | 1,105.75 |
| Public Health Use | 16.11 | 17.28 |

**By point of entry,** the table below shows that the Benque Viejo western border recorded the highest imports cleared for 2021 which is an increase of 2.70% compared to 2020. On the other hand, Port of Belize recorded a decrease of 53.64% compared to previous year. The other two points of entry recorded increases for 2021 as well. Overall, Benque Viejo recorded 77% of total imports for 2021 and Port of Belize recorded 20% of total imports.

| Total AI (MT) | 2020 | 2021 |
|---|---|---|
| Big Creek Port | 5.28 | 32.07 |
| Benque Viejo western border | 841.96 | 864.77 |
| Port of Belize | 487.37 | 225.92 |
| Santa Elena northern border | 0.063 | 0.259 |

**Imports records by month**

As can be seen with this graph, August of 2020 recorded a huge increase in imports compared to 2021 and to the other months of the year. The peak months are February, March, June, August, October and November.




**Top 10 most used pesticides in Belize**

The table below shows the top 10 most used pesticides in Belize for the year 2020 and 2021. For the year 2021, Mancozeb was the most used pesticide in Belize. Of the top ten, nine are herbicides and one insecticide. Six are classified as *Restricted Use* and the rest as *General Use*.

| Total AI (MT) | 2020 | 2021 |
|---|---|---|
| Mancozeb | 154.97 | 203.33 |
| Glyphosate | 189.24 | 157.81 |
| 2,4-D | 91.03 | 67.49 |
| Atrazine | 63.01 | 41.95 |
| Paraquat | 49.97 | 36.69 |
| Diuron | 67.42 | 13.85 |
| Ametryn | 42.30 | 26.00 |
| Malathion | 21.44 | 17.97 |
| Terbutryn | 19.75 | - |
| Pendimethalin | 10.78 | 6.425 |

# Lemongrass Oil Made in Belize

## By Dr. Thomas Mathew

Our experimentation to make lemongrass oil at the Belize Spice Farm was a success. We found out that it takes 450 lbs. of lemon grass cuttings to produce about 10 oz. of oil. Many distilleries produce almost double the amount; as we gain more experience with harvesting and distillation, we hope to match the yield of big time growers. Based on initial success we started a lemon grass nursery using seeds; they germinate easily in our clay soil and are ready for transplanting within 2 to 3 weeks. In the field the seedlings are spaced about 8 inches apart in rows spaced about 12 inches. In our experience we found water logging kills the plant or slows down the growth. However, the plants are hardy and heat tolerant and grow fast in Belize; we can start harvesting in 4 months. Harvesting can actually be done 4 to 6 times per year. There is no need for any type of fertilizer or pesticide. Lemon grass multiplies fast and grows tall very fast, choking out weeds. Forty thousand to 50,000 lbs. can be harvested from 1 acre.

2 weeks old lemongrass

2 months old lemongrass

Lemon grass is grown widely in many tropical countries including Caribbean countries. The variety seen in Belize and other Caribbean countries is called fever grass (*Cymbopogon citratus*). The type grown in India is called by different local names, but the scientific name is *Cymbopogon flexuosus*. We grow both, but use the *C. flexuosus* for oil making.

It took many starts and stops to build a distillery from locally available parts but it was finally functional in about 6 months. We built a boiler to make steam that passes through the big extractor that stores the grass and a condenser and cooling tower that cools the steam to water. Of course we had to build a cooling system to operate the condenser. The last piece of equipment we built was a water separator. The boiler produces steam at a temperature of 100° to 120° C (212° – 248° F) that passes through tubes to the distillery at 10 lbs. pressure. The output from the distiller is steam with oil. The condenser and cooling tower are important to the process to rapidly cool the steam and oil to water and oil which easily separate since oil floats to the top of the water.

Lemon grass oil is widely used in herbal tea, perfumery, and soap making; it is a source of vitamin A and is also an insect repellant. There are many medical uses for lemon grass oil.

**Harvesting**

Lemon grass farming is ideal for Belize and can create yet another export industry. We have local farmers growing lemon grass for us; we encourage our neighbours within 5 to 10 miles away to grow lemon grass and have supplied free seedlings to those who took up the offer. Contact us at goldenstreamspicefarm@gmail.com for more information.

***Editor's Note: Dr. Thomas Mathew, retired anesthesiologist, established the Belize Spice Farm (BSF) over 20 years ago with mother plants imported from Kerala, India, Dr. Mathew's native home, where his family grew them. The BSF is located in Golden Stream, Toledo.***

**Have you a suggestion for an article topic or have a finished article about Belizean agriculture to share?.....**

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***Fruits, Roots, and Shoots - Using Tropical Plants for Self-Sufficiency*** is a new book published by Deborah Harder. It is available in spiral binding from Deborah or Dottie Feucht dottiefeucht@protonmail.com or in standard binding online from www.amazon.com

# Sorrel (Roselle): Part 2

## By Deborah Harder and Dottie Feucht

Issue 44 of the Belize Ag Report covered the introduction and history of sorrel *(Hibiscus sabdariffa)*. Being popular in subtropical regions all over the world, it has many local names and uses. Although countries in Africa and Southeast Asia are the major suppliers on the global market, Mexico and Jamaica are important suppliers in our region. Dried sorrel is sold in the local produce markets.

**Cultivation -** An attractive plant in the hibiscus family, sorrel has been recommended to plant as a temporary hedge. We usually raise it in the garden in the winter. Seeds are started in trays and the plants set out about 3' apart. They can also be started from cuttings. The plants produce showy yellow flowers that mature into clusters of edible red "petals" (sepals) beneath the bloom. These sepals swell and become fleshy and succulent. Eventually they envelop the seed pod formed from the female part of the flower. They look like buds; they are the part of the plant used as the fruit, usually ready for picking in December.

**Use –** Prepare the buds by scoring around the base with a sharp knife, to separate the edible outer portion from the middle ball which contains the seeds. The seed ball can be discarded and the fleshy red petals-like portion reserved to use. The red, fleshy parts can be boiled, strained, and sweetened, and used as a hot or cold beverage. The juice can be made into jelly, or by not straining out the pulp, into jam. The flesh can be also made into pie by sprinkling liberally with sugar and baking in a pie crust. Being rich in pectin it is easy to make pies and jams. The main disadvantage of sorrel is the amount of sugar it requires due to its sourness. But it is very nutritious all the same. Beverages of the calyces are extensively used in Mexico as diuretic, for treating gastrointestinal disorders, liver diseases, fever, hypercholesterolemia and hypertension.

Besides pectin the fleshy flower calyces are rich in citric acid, anthocyanin pigments and vitamins and are also used fresh in salad and for making wine, syrup, gelatin, puddings, chutneys, pickles, cakes, herbal teas, ice cream, sherbets, sauces, tarts and other desserts. Sorrel drink is popular in the Caribbean, especially at Christmas. It is used alone or in herbal teas to add flavor and red color.

***Sorrel Drink***

Prepared sorrel buds
Water
Sugar

Cover sorrel with water. Bring to a boil and remove from heat. Strain and reserve pulp. Sweeten and dilute to taste with hot water for a hot drink; sweeten, cool, and dilute with cold water for cold drink. One pint strong juice makes about 2 qt. drink. Undiluted juice may also be poured hot into jars and sealed for later use.

***Sorrel Banana Jam (recipe of Mrs. Sam Miller)***

Start with any amount of sorrel, cleaned. Measure cleaned portion and add equal amount of ripe bananas. Combine in thick-bottomed pot. Add small amount of water and cook until done.

Measure cooked sorrel and bananas. Add equal amount of sugar. Bring to a boil and simmer, stirring often, scraping bottom to prevent scorching. Remove when thick and syrupy.

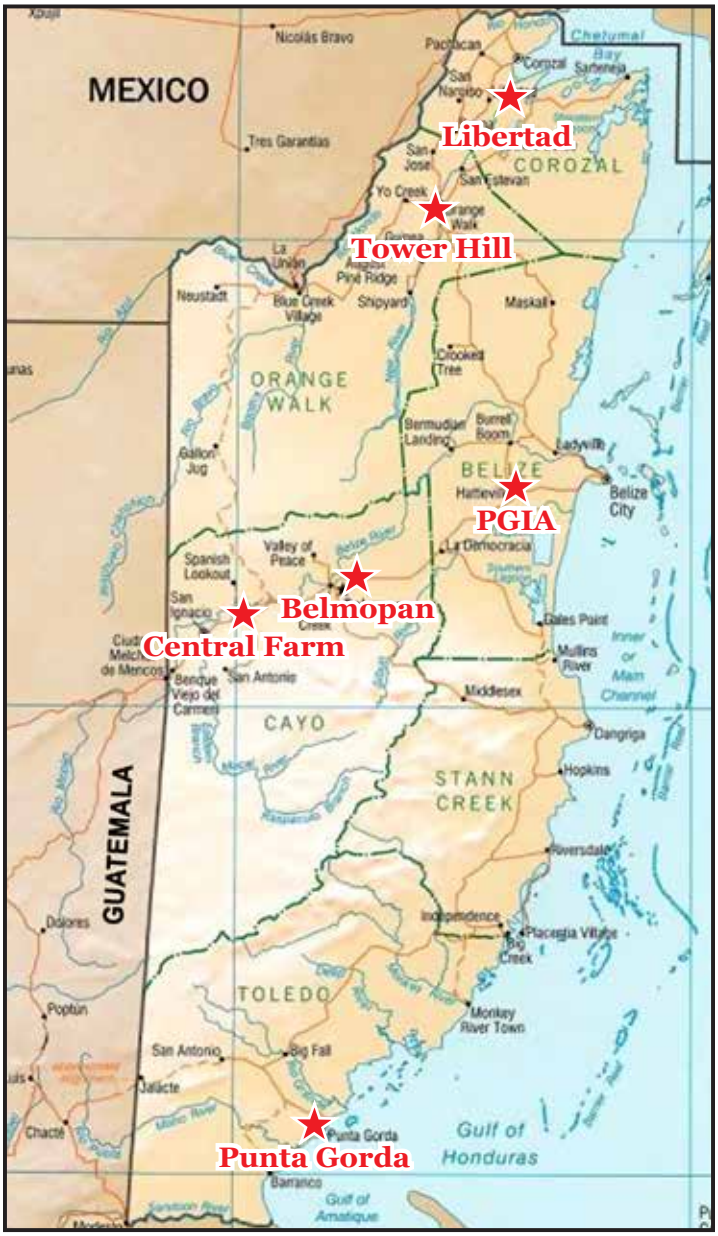
A large amount can be canned in pint jars in a water bath for ten minutes.

**Nutritional and Medicinal Value** - Sorrel is famous for its high nutritional and medicinal values. It is a wonderful source of antioxidants. Among its nutrients are calcium, iron, vitamins A, B1,2, and 3, and C, magnesium, potassium, and phosphorus. It has been used as a therapeutic plant for centuries all over the world, especially in Africa and the Far East. Traditionally, extracts treat toothaches, urinary tract infections, colds, and even hangovers. In Senegal, the juice of leaves treat conjunctivitis and, when pulverized, soothes sores and ulcers. Root concoctions act as a potent laxative. Natives of various countries drink tea to stabilize blood pressure and lower cholesterol. The high calcium content is used to protect teeth by keeping the jaw bone strong starting at a young age. The iron content is beneficial for pregnant women. The high vitamin C facilitates the absorption of iron, thus strengthening the body's resistance to infection. Vitamin C is well known for enhancing the immune system, which protects us from colds and coughs and has been shown in many studies to fight successfully against viruses. The magnesium provides relief from constipation by relaxing the intestinal muscles. It also has another property of attracting water, which in turn softens the stool and helps it to pass easily. The phosphorus content is known for its ability to remove minor health problems like muscle weakness, numbness, fatigue and other similar ailments.

# Rainfall 2020 & 2021

Although the trend of lower rainfall in northern Belize, and higher rainfall in the south still remains generally true, much variation can be seen within each area.

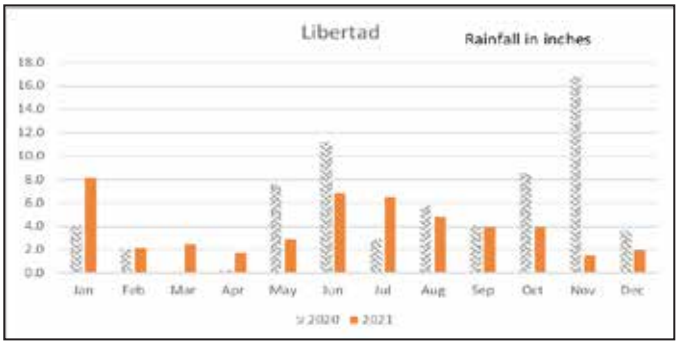
*All of the rainfall charts and graphs for this article were created by Dottie Feucht.*




## Rainfall - Libertad
### Corozal District

Libertad rainfall courtesy of Belize HydroMet

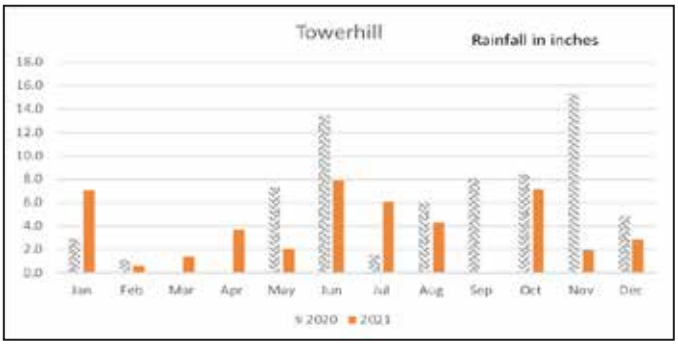
| Month | 2020 Rainfall in. | 2021 Rainfall in. | 2020 Precip (mm) | 2021 Precip (mm) |
|---|---|---|---|---|
| Jan | 4.1 | 8.2 | 104.8 | 207.4 |
| Feb | 2.0 | 2.1 | 51.2 | 53.8 |
| Mar | 0.1 | 2.5 | 3.6 | 63.2 |
| Apr | 0.2 | 1.7 | 6.2 | 43 |
| May | 7.5 | 2.9 | 191.6 | 72.6 |
| Jun | 11.2 | 6.8 | 285.6 | 173.4 |
| Jul | 2.9 | 6.5 | 72.8 | 165.2 |
| Aug | 5.8 | 4.8 | 147 | 122.8 |
| Sep | 4.0 | 4.0 | 102.6 | |
| Oct | 8.5 | 4.0 | 216.8 | 101.0 |
| Nov | 16.8 | 1.6 | 427.4 | 39.6 |
| Dec | 3.7 | 2.0 | 93.8 | 50.4 |
| **Totals** | **67.1** | **47.0** | **1703.4** | **1092.4** |




## Rainfall - Tower Hill
### Orange Walk District

Tower Hill rainfall courtesy of Belize HydroMet

| Month | 2020 Rainfall in. | 2021 Rainfall in. | 2020 Precip (mm) | 2021 Precip (mm) |
|---|---|---|---|---|
| Jan | 2.9 | 7.1 | 74.6 | 180.0 |
| Feb | 1.2 | 0.6 | 29.4 | 14.8 |
| Mar | 0.0 | 1.4 | 1.2 | 35.6 |
| Apr | 0.0 | 3.7 | 0 | 94.8 |
| May | 7.3 | 2.1 | 185.7 | 52.2 |
| Jun | 13.5 | 7.9 | 341.8 | 201.4 |
| Jul | 1.6 | 6.1 | 39.8 | 154.3 |
| Aug | 6.1 | 4.3 | 154.3 | 109.2 |
| Sep | 8.1 | | 205.4 | |
| Oct | 8.5 | 7.2 | 215.8 | 182.0 |
| Nov | 15.3 | 2.0 | 389.4 | 50.0 |
| Dec | 4.9 | 2.9 | 124.2 | 73.0 |
| **Totals** | **69.4** | **45.2** | **1761.6** | **1147.3** |



# Rainfall - Phillip Goldson Intl Airport
## Belize District

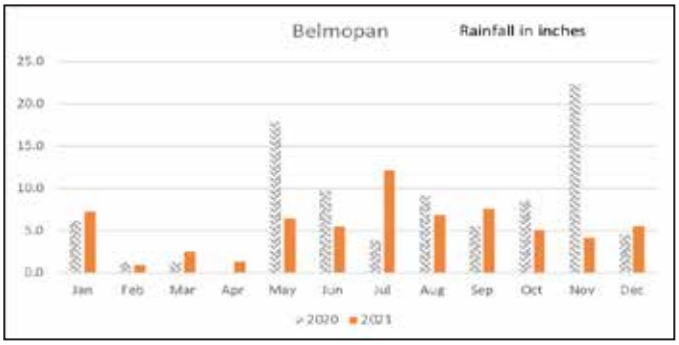
PGIA rainfall courtesy of Belize HydroMet

| Month | 2020 Rainfall in. | 2021 Rainfall in. | 2020 Precip (mm) | 2021 Precip (mm) |
|---|---|---|---|---|
| Jan | 7.0 | 7.5 | 178.4 | 190.5 |
| Feb | 1.3 | 3.1 | 32.5 | 79.7 |
| Mar | 0.9 | 1.5 | 22.0 | 39.3 |
| Apr | 0.0 | 2.8 | 0.0 | 71.7 |
| May | 9.0 | 5.3 | 228.0 | 135.0 |
| Jun | 8.1 | 6.0 | 205.0 | 153.2 |
| Jul | 2.8 | 6.0 | 72.0 | 152.9 |
| Aug | 3.1 | 3.9 | 79.2 | 99.2 |
| Sep | 8.6 | 8.5 | 217.3 | 216.8 |
| Oct | 10.5 | 16.2 | 266.7 | 411.6 |
| Nov | 32.4 | 5.3 | 823.3 | 135.1 |
| Dec | 6.3 | 3.9 | 159.1 | 100.3 |
| **Totals** | **89.9** | **70.3** | **2283.5** | **1785.3** |


# Rainfall - Belmopan
## Cayo District

Belmopan rainfall courtesy of Belize HydroMet

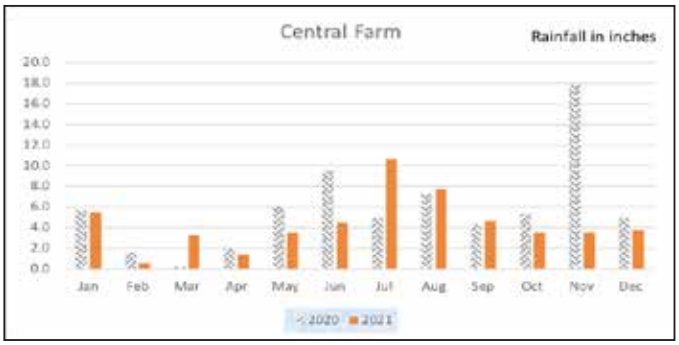
| Month | 2020 Rainfall in. | 2021 Rainfall in. | 2020 Precip (mm) | 2021 Precip (mm) |
|---|---|---|---|---|
| Jan | 6.2 | 7.3 | 157.6 | 184.4 |
| Feb | 1.3 | 1.0 | 32.6 | 24.4 |
| Mar | 1.3 | 2.6 | 34 | 64.8 |
| Apr | 0.0 | 1.4 | 0 | 35.9 |
| May | 17.9 | 6.5 | 455 | 164.5 |
| Jun | 9.8 | 5.5 | 247.8 | 140.3 |
| Jul | 3.8 | 12.2 | 97 | 309.5 |
| Aug | 9.2 | 6.9 | 233 | 175.4 |
| Sep | 5.6 | 7.7 | 142.7 | 194.6 |
| Oct | 8.6 | 5.1 | 218.2 | 129.1 |
| Nov | 22.4 | 4.2 | 568.1 | 105.8 |
| Dec | 4.6 | 5.6 | 117.6 | 142.2 |
| **Totals** | **90.7** | **65.8** | **2303.6** | **1670.9** |




# Rainfall - Central Farm
## Cayo District

Central Farm rainfall courtesy of Belize HydroMet

| Month | 2020 Rainfall in. | 2021 Rainfall in. | 2020 Precip (mm) | 2021 Precip (mm) |
|---|---|---|---|---|
| Jan | 5.6 | 5.4 | 143.1 | 137.7 |
| Feb | 1.6 | 0.6 | 40.6 | 14.2 |
| Mar | 0.3 | 3.3 | 6.9 | 83.8 |
| Apr | 2.0 | 1.4 | 50.4 | 35.3 |
| May | 6.0 | 3.5 | 153.6 | 89.1 |
| Jun | 9.6 | 4.5 | 244.4 | 114.1 |
| Jul | 4.9 | 10.7 | 125.4 | 270.7 |
| Aug | 7.2 | 7.7 | 183.9 | 196.5 |
| Sep | 4.3 | 4.6 | 109.7 | 116.8 |
| Oct | 5.3 | 3.5 | 134.5 | 88.7 |
| Nov | 17.9 | 3.5 | 453.5 | 88.3 |
| Dec | 4.9 | 3.7 | 125.5 | 93.7 |
| **Totals** | **69.7** | **52.3** | **1771.5** | **1328.9** |




# Rainfall - Punta Gorda
## Toledo District

Punta Gorda rainfall courtesy of Belize HydroMet

| Month | 2020 Rainfall in. | 2021 Rainfall in. | 2020 Precip (mm) | 2021 Precip (mm) |
|---|---|---|---|---|
| Jan | 5.75 | 3.69 | 146.0 | 93.8 |
| Feb | 1.32 | 0.92 | 33.5 | 23.3 |
| Mar | 3.93 | 3.29 | 99.9 | 83.6 |
| Apr | 0.00 | 3.17 | 0.0 | 80.6 |
| May | 11.97 | 10.11 | 304.0 | 256.9 |
| Jun | 9.41 | 10.16 | 238.9 | 258.1 |
| Jul | 14.03 | 19.60 | 356.4 | 497.8 |
| Aug | 17.96 | 22.54 | 456.1 | 572.6 |
| Sep | 15.71 | 17.93 | 399.1 | 455.3 |
| Oct | 15.73 | 10.16 | 399.5 | 258.0 |
| Nov | 16.85 | 3.84 | 427.9 | 97.6 |
| Dec | 4.42 | 7.60 | 112.2 | 193.0 |
| **Totals** | **117.07** | **113.02** | **2973.50** | **2870.60** |

# Hemp as Food

## By William Grimshaw

**Food For Thought**

For many years it was believed that hemp was destined only for developed nations; they make the rules and they have the resources; Belize is too small and we don't have enough farmers. Sure, some of those things may be true, but not entirely. Delving deep into what hemp is, we come across its roots, spread far and wide, branching into hundreds if not thousands of extensions of itself. Yet only by tapping into its core do we find its real purpose, its true value. Here we find hemp nurturing us with sustenance, providing us with the means to extend our strength and giving us peace of mind.

This is evident by its consistent veneration throughout history, even known in Hebrew scripture as the holy anointing oil, sweet scented cane. Ancient Chinese literature refers to hemp as "of the 5 grains", barley, soy, rice, wheat and hemp. Songs and stories pass on the primordial means for the amelioration of society. To quote Ecclesiastes 1:9: "What has been will be again, what has been done will be done again; there is nothing new under the sun."

Only in recent times was hemp subjected to prohibition; but now the constraints are waning. Aristotle's philosophy "you are what you eat" has never been more relevant than now in modern times and is largely the driving force for hemp's reawakened demand. The need for higher value food crops is imperative because we are not able to maintain our balance with nature and the need to sustain ourselves. This ancient crop offers solutions to some of these modern problems; it only takes willing minds, seasoned hands and the reverence and love for our children and theirs.

**Hemp Food & the Market**

Hemp is vastly becoming a staple product in our everyday diets as its secrets are brought to light. Healing us from within, hemp seeds are packed with essential fats, proteins and nutrients repairing damage, improving our well-being with every bite. The value of the grain is not only calculated by what it can do for us, but also for the earth. Improving soil in every rotation, reducing the need and impact of harmful chemicals, hemp is the answer to a healthier self and environment.

Hemp grain offers us an opportunity to not only provide sustenance but also a means to prosper as we take advantage of its true worth, especially during uncertain times. The demand is exceeding its supply as more people learn of its nutritional value; but as the market expands its production is being stalled by astounding limitations in who can or cannot grow hemp. Here lies the opportunity as we in Belize have the means, the seeds and the land.

TropiCann Foods Ltd. is the primary hub for hemp grain processing and value adding in Belize. TropiCann ensures that high quality products enter the markets effectively. Exercising restraint and precision, we have efficiently grown and harvested food grade hemp in Belize. We encourage industrial and small-scale farmers to pursue hemp grain as a viable option for increased revenue and soil remediation with every rotation.

**Growing the Crop**

Hemp for grain is grown like a conventional rotational crop with slight variations in methodology. Hemp seeds are small; the average size ranges from .12 to .14 inches (3 – 3.5 mm), therefore resulting in a delicate seed with specific sowing conditions. Despite the seeds' size, hemp, once planted under the right conditions, produces a sturdy drought tolerant crop. Hemp requires roughly 4-30 inches (101.6 – 762 mm) of water during its life time.

**Planting Season & Soil**

Planting according to our soil and the season is vital for large scale operations. Gauging the rains is important as too much too soon causes rot and too little stunts yields. The rains also provide essential micro nutrients the crop heavily depends on. In Belize, our soils are generally sulphur deficient; the only natural source of sulphur available to crops comes from rain. (The alternative is heavy chemical fertilizers.) Heavy clay soils require a shallow sowing depth of 0.5 inch (12.7 mm) to avoid crusting on the top layer of soil. This hard surface can prevent the seeds from emerging, resulting in crop failure. Looser and lighter soils require a lower sowing depth of 1 inch (25.4 mm) in order for the crop to maintain its stature and prevent crop folding. Hemp for grain can be grown all year round across Belize.

**Sowing Parameters**

Row spacing varies between 7 to 8.5 inches (177. 8 – 216 mm). This is essential to ensure field coverage in order to prevent the emergence of weeds. A seed drill is the most affordable and effective implement for the sowing of hemp seed. Hemp seeds can stay in the soil for about 3 to 4 days depending on external temperatures. Seed die-off begins to occur due to damage from prolonged heat exposure without sufficient moisture. Optimal time to sow is 1-2 days before the rain.

**Pest Control**

Non-organic post-emergent pesticides or herbicides **are strictly prohibited**. The reason is that *Cannabis sativa L.* is a hyper accumulator, drawing heavy metals and toxins from the soil and incorporating them into its structure. The majority of these heavy metals are absorbed primarily into the stems, leaves and flowers. Seeds incorporate small amounts of these toxins that are detectable through proper screening. So, it's obvious why the use of non-organic post-emergent pesticides or herbicides is strictly prohibited.

**Harvesting**

Industrial hemp is harvested when the seed begins to shatter. Standing hemp is harvested when approximately 70% to 80% of the seeds are ripe and the grain moisture range is 10% to 20%. A major indicator that you are near harvest, is the die-off of male plants. These tend to die roughly 10-15 days before the seeds reach maturity. With a life-cycle of 120-160 days

(depending on the time it's grown) harvesting is best during a dry spell. This is imperative to ensure ease of harvest and minimize loss of grain.

An agronomical guide has been developed for Belize, with parameters set for the central and northern locations.

**Economic Opportunity**

What a great opportunity for the farmers of Belize to diversify their crops to include hemp! The hundreds of uses of hemp grain are opening up new business opportunities for entrepreneurs and expanding farming enterprises in other countries and can do the same in Belize. The market is open and waiting for those who are willing to take little risk for substantial financial reward.

***Editor's note:*** *William Grimshaw was raised in southern Belize in a constantly evolving farming environment where the birth of industries sparked a new light. TropiCann Foods was founded in 2016 with the dream to build industry and spur diversification by means of industrial hemp grain. The company's focus is to contract with farmers for grain and add value for exportation, bringing and keeping the value home. tropicannfoods@gmail.com*

# HLB - Citrus Greening: Performance Nutrition Leading the Way

**By John Flynn**

Comments like "I have tried everything under the sun" by frustrated citrus growers trying to solve the greening disease were widely heard over the past several years. However, those who have stopped what they have been doing, including applying pesticides, and begun the Performance Nutrition program, adding organic matter and microbials to the soil and allowing the trees time to heal are saying "I doubted that merely changing agronomic practices I could produce citrus again." They are back in business. And their production costs are typically being reduced from $2,000–3,500 per acre for counterproductive pesticides and fertilizers to around $500 per acre.

The disease is generally assumed to be caused by a bacterium called *Candidatus Liberibacter asiaticus*, which is thought to be spread by an insect called the Asian citrus psyllid. But in order to prove that any given bacterium causes any given disease, criteria known as Koch's Postulates have to be met. In the case of *Candidatus Liberibacter asiaticus*, they have never been met. That is why *Candidatus* (candidate) should always be used in front of the name (although most of the time it is omitted); HLB is still "under investigation." The organism has even resisted attempts to grow it in culture – the second postulate. Research on various sprays targeted against the suspected bacterium has mostly resulted in failure.

A plant pathologist from FL has shown that the disease is actually a metabolic and nutritional problem in plants caused in part by the overuse of pesticides, especially glyphosate compounds, which are used in non-organic citrus orchards to kill weeds and grass around trees. Glyphosate compounds block the shikimate pathway, which is responsible for the production of the three aromatic amino acids that are essential for plant growth and health: tryptophan, tyrosine and phenylalanine. Tryptophan is converted to a plant hormone that helps the tree make strong roots, and phenylalanine and tyrosine are natural plant antibiotics that protect the tree from diseases and parasites. Glyphosate causes the leaves on the trees to turn yellow as glyphosate is well known as a chelating agent, and as such binds up the minerals in the soil, making them unavailable to the tree. Reducing beneficial soil bacteria can result in large colonies of fungi (fusarium), further reducing the availability of nutrients to plants.

A company in FL developed a product called NutriSmart® which breaks the carbon-phosphorus bond in glyphosate, ending its herbicidal effect and allowing the affected plants to recover to productivity. The commercial program in Belize called Performance Nutrition Citrus Program focuses on soil health to restore and grow healthy trees that are much more resistant to HLB and other diseases. The replicated results that have been seen across the citrus growing regions in Florida is proof that the right combinations of these patented products can eradicate HLB along with post fruit drop (PFD). In an effort to better understand how its citrus program eliminated PFD from the groves it has been treating, Performance Nutrition retained the global research technical company Biome Makers to identity and map the microbial composition in the soil in three locations in Central and South Florida. Analyses of the impact on the soil microbiome of the applications included the patented Performance Citrus Management Program which uses Biome Makers' Gheom Platform and methodology. The results of the trial work were very impressive! Key findings included:

- A 60-99.9% reduction of the presence of Colletotrichum acutatum pathogenic fungi in the treated soil, decreasing the risk of Post Bloom Fruit Drop and Anthracnose.
- A large increase in microbial biodiversity in the soil where NutriSmart-B and NutriSmart WSP were applied along with patented Korban Zn technology.
- A large increase in bioavailabilty of macro-and micro-nutrients as well as an increase in hormone producing microbes.


Brad Turner a grower who has been working with the Performance Nutrition citrus program said recently that "It is nothing short of amazing to see the success and transformation" of his groves. The Valencia oranges and the Ruby Red grapefruit are growing in nice clusters with virtually no fruit drop!

In the picture of Eric Barkwell's grove notice the difference between the trees on the left with those on the right; the soil of those on the left was treated about 8 months before the picture was taken and at 18 months the trees showed signs of vibrant health, having flowered correctly and setting fruit that was harvested. In the same grove, only a few yards away, the untreated soil of the trees on the right show condition of the trees prior to treatment; the dramatic difference between healthy and non-productive trees is based on soil health.

Regenerative agriculture is a sustainable way of farming that focuses on soil regeneration, increasing biodiversity, improving the water cycle and enhancing the ecosystem. For further information please contact:

John Flynn
East Coast U.S. and Caribbean Business Manager
Performance Nutrition
941-232-6704
John@pnfertilizers.com

# Belize Coconut National Stakeholder Platform and the Lead Farm Approach

**By Omaira Avila Rostant**

The 2nd phase of the Coconut Development project funded by the European Union (EU) and CARIFORUM through the Alliences for Coconut Industry Development Expansion and Enhanced Support for the Caribbean is being implemented in the Caribbean since 2019 by the International Trade Centre (ITC) and the Caribbean Agricultural Research and Development Institute (CARDI). The project 2nd phase that started in September 2019, has been supported by the Ministry of Agriculture of each country. In Belize, the Ministry of Agriculture, Food Security and Enterprises (MAFSE) and the Project National Coconut Stakeholder members of the Platform (NCSP), despite COVID 19, have supported the project implementation and worked hard in the drafting of an inclusive road map for the industry which seeks to provide training, planting material, finance options and standards to improve processing to further develop the sector.

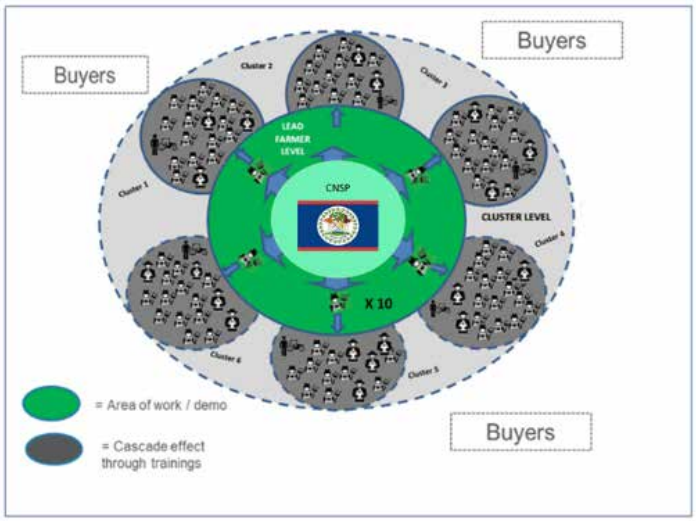



**Fig 1:** Caribbean Coconut Development Project networking impact: *Lead Farm approach.*

To develop the sector, there are two limiting factors: access to elite planting material, and trained farmers to effectively manage their farms and produce superior coconuts to improve the coconut production quality in Belize. The time and cost required to visit, train and monitor progress of coconut farmers is extremely high, and requires much more than what is available in the project to make an impact in this area. Thus the project has adopted a methodology known as the *lead farm approach* as its training approach.

The lead farm approach is an extension approach which encourages farmers to learn from each other. This approach is a farmer-led

***Continues on page 34***

# Agriculture Prices at a Glance- $$$$$ 25-31 MARCH 2022

A-B denotes the difference between 1st preference & 2nd preference and sometimes between wholesale & retail and bulk or small amounts.
Trend (H) means Higher over last 30 to 60 days (L) Lower (S) Steady. A blank symbol (-) denotes that the item is either not available now or at the time of the last issue.
Prices intend on being farm gate in Belize dollars - usually price per lb

| BELIZE CATTLE by District - Provided by BLPA | | Dist. | Per lb | Dist. | Per lb | Dist. | Per lb |
|---|---|---|---|---|---|---|---|
| Fattened steers | H/H/H | Czl | 1.90 | OW | 2.00 | Bze | 1.90 |
| 750-1100 lbs | H/H/H | Cy | 2.00 | SCr | 1.80 | Tol | 1.90 |
| Weaner steers | H/H/H | Czl | 1.75 | OW | 1.75 | Bze | 1.70 |
| " " | H/H/H | Cy | 1.85 | SCr | 1.70 | Tol | 1.70 |
| Breeding heifers | H/H/H | Czl | 1.60 | OW | 1.70 | Bze | 1.65 |
| " " | H/H/H | Cy | 1.65 | SCr | 1.65 | Tol | 1.65 |
| Cull cows | H/H/H | Czl | 1.00-1.20 | OW | 1.00-1.25 | Bze | 1.00-1.25 |
| " " | H/H/H | Cy | 1.00-1.25 | SCr | 1.00-1.20 | Tol | 1.00-1.25 |

| BELIZE DAIRY CATTLE - provided by The Belize Dairy Association | | |
|---|---|---|
| Dairy heifers, breeding age by the head | - | $3,500.00 To $5,500.00 |

| U.S. CATTLE | | |
|---|---|---|
| U.S. price - corn fed - 1000-1200 lbs | H | US$ 1.41 |
| U.S. price - feeders 600-800 lbs | H | US$ 1.56 |

| BELIZE HOGS - Provided by Belize Pig Council | | | |
|---|---|---|---|
| Weaner pigs - 25-30 lbs - by the head | H | 120.00 | |
| Butcher pigs 160 - 230 lbs, per lb | H | 2.05 | 2.25 |

| BELIZE SHEEP | | | |
|---|---|---|---|
| Butcher lambs - live per lb | H | 2.50 | |
| Mature ewes - live per lb | S | 1.75 | 1.35 |

| BELIZE CHICKEN | | | |
|---|---|---|---|
| Wholesale dressed, per lb (Sp Lkt) | H | 2.50 | Large Birds 2.32 |
| Wholesale dressed, per lb (Bl Crk) | H | 2.46 | |
| Broilers - live per lb (Sp Lkt) | H | 1.28 | |
| Broilers - live per lb (Bl Crk) | H | 1.28 | |
| Spent hens (Sp Lkt) | H | 0.90-1.30 / lb fluctuating | |
| Spent hens per 4 lb bird (Bl Crk) | H | 0.90 / lb | |

| CITRUS | | |
|---|---|---|
| Oranges per lb solid, estimate only | H | 2.3249 pps. (13.7168 / box) |
| Grapefruit per lb solid, estimate only | H | 4.1257 pps. (16.0901 / box) |

| COCONUTS | | |
|---|---|---|
| Green Coconuts, bulk | S | 0.30 - 0.60 / per coconut |
| Dry Coconuts, bulk | S | 0.35 - 0.50 / per coconut |

| GRAINS, BEANS & RICE | | | |
|---|---|---|---|
| Belize yellow corn, bulk (Spanish Lookout) | H | $37.00 / 100 lbs | |
| Belize yellow corn, bulk (Blue Creek) | H | $36.00 / 100 lbs | |
| Belize white corn, bulk (Cayo District) | H | $40.00 / 100 lbs | |
| US Corn, #2 yellow | H | US$7.54 / 56 lb bushel | |
| US organic, #2 yellow corn feed grade | H | US$9.50-10.50 / bushel | |
| Belize soy beans (Spanish Lookout) | H | 0.65 | 0.67 on payments |
| Belize soy beans (Blue Creek) | H | 0.65 | 0.67 on payments |
| US soy beans | H | US$ 16.1825 / bushel | |
| US organic, #1 feed grade soy | H | N/A. (last price US$ 24.23) | |
| Belize milo (Spanish Lookout) | H | 28.25 / 100 lbs | |
| Belize milo ( Blue Creek) | H | 29.00 / 100 lbs | |
| Red kidney beans (Spanish Lookout) | L | $100.00 / 100 lb bag, for export | |
| Red kidney beans (Blue Creek) | - | N/A | |
| Black eyed peas (Spanish Lookout) | S | 0.90 | |
| Paddy rice per pound (Spanish Lookout) | H | 0.50-0.60 farm price, dried | |
| Paddy rice per pound (Blue Creek) | H | 0.60 farm price, dried | |

| SUGAR/HONEY | | |
|---|---|---|
| Sugar cane, ton, 2nd est for yr | L | $53.17 |
| Bagasse, per ton | - | quantum to be determined at end of year |
| Honey, 5 gal (approx 60 lbs) | S | $240.00 expected to rise (CQHPC) |
| Honey, specialty, 5 gal (approx 60 lbs) | H | $275.00 |

| SPECIAL FARM ITEMS | | | |
|---|---|---|---|
| Eggs - tray of 30, farm price | H | 5.42 (Sp Lkt) | 5.70 (Blue Creek) |
| WD milk/lb farmer base price, contract only | L | 0.49 – 0.52 (prior was 0.51-0.54) | |
| Raw milk (farmer direct sales) | S | 5.00 per half gal | |

| CACAO | | |
|---|---|---|
| Cacao beans organic | H | 3.00 - 3.50 / lb dried fermented beans |
| Cacao beans organic | H | 1.10 / lb wet beans |
| US Cacao beans, metric ton (ICCO) | H | US$ 2,498.87 |

*Wet beans lose up to 70% of their weight during fermentation, drying and roasting.*

*Find link to all of the Prices at a Glance pages (back to 2009) on our website: www.agreport.bz*

****These prices are the best estimates only from our best sources and simply provide a range to assist buyers and sellers in negotiations.****

# A Carbon Friendly Beef Enterprise - Is It Possible?

**By Christine Jones, PhD**
**Founder, Amazing Carbon**
**www.amazingcarbon.com**

There are many misconceptions surrounding the contribution of livestock to climate change. The United Nations publication, 'Livestock's Long Shadow' (1), resulted in calls from around the world for reduced meat consumption on the basis that livestock were a major contributor to greenhouse gases. Concerns have also been expressed that meat consumption has a detrimental effect on human health.

The reality is that both the carbon footprint and dietary effects of beef are determined by how it is produced.

The United Nations report (1) suggested that livestock contribute 18% of global greenhouse gas emissions, a figure higher than all the world's transport sectors combined. It has since been acknowledged that the calculations were seriously flawed (2, 3), due to the inclusions of many indirect factors such as clearing Amazonian rainforest for crop and pasture production.

American Meat Institute president and chief executive officer J. Patrick Boyle noted that according to the Environmental Protection Agency, livestock contributed only 2.8% to US greenhouse emissions in 2007, a figure that had remained relatively constant since 1990 (3).

In Australia, it has been widely promoted that livestock are a significant contributor to atmospheric methane and that global methane levels are rising. However, there is no scientific data to suggest that methane emissions from ruminant sources are increasing. Indeed, it would seem there has been **no clear trend to changes in global methane levels, from any source, over recent decades**.

The increase in global methane levels from 1930 to 1970 was due to emissions from the production, transmission and distribution of natural gas (4). There was a tenfold increase in the use of natural gas through the 1960s and 1970s. The source of many of the natural gas emissions, such as leakages from the Trans-Siberian pipeline, have since been rectified (4). Measurements over the last 25 years show concentrations of atmospheric methane are merely exhibiting natural variation, with no significant trends in any direction (Fig.1).

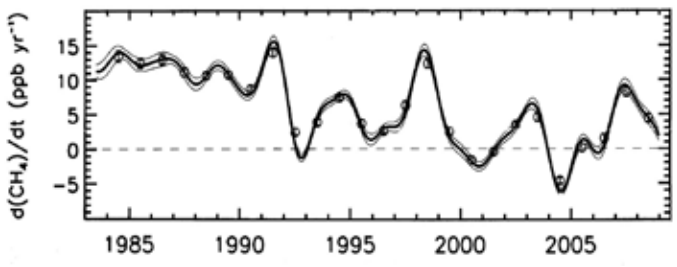



**Fig. 1.** Variations in annual change in atmospheric methane concentration from 1983 to 2009, from Dlugokencky et al (2009). Measurements are in parts per billion per year (5).

There is no scientific basis for selectively targeting ruminants for a 'methane tax'. The evolution of the rumen as an efficient way of digesting plant material evolved around 90 million years ago. It seems extraordinarily inappropriate to interfere with this natural process.

Ruminants including buffalo, goats, wild sheep, camels, giraffes, reindeer, caribou, antelopes and bison existed in greater numbers prior to the Industrial Revolution than are present today. There would have been an overwhelming accumulation of methane in the atmosphere had not sources and sinks been able to cancel each other over past millennia.

Recent research undertaken by Professor Mark Adams, Dean of the Faculty of Agriculture at Sydney University, has found that biologically active soils can oxidise the methane emitted by cattle carried at low stocking rates (6). This is due to the activity of methanotrophic bacteria, which utilise methane as their sole energy source (7). Soil methanotrophs counter the effects of methanogens, the bacteria that combine carbon and hydrogen, reducing acidosis in the rumen.

Methane emitted from livestock has a very short cycle, that is, it is generally recycled rather than moving to the upper atmosphere. Industrial emissions, on the other hand, are far more likely to enter the stratosphere. We see a similar trend with water vapour, which has a short cycle if transpired by pasture (much of it returning overnight as dew), but a long cycle (moving to the stratosphere) if evaporated from bare earth or emitted from industrial sources.

Additionally, a complete life-cycle analysis reveals that appropriately managed rotationally grazed perennial grasslands, where atmospheric carbon is sequestered in soil as stable humus, result in more carbon sequestered than emitted, easily compensating for the methane produced by livestock.

**Fig. 2.** The dark coloured carbon sequestered around the roots of perennial grasses is readily observed in light coloured soils. (Photo Christine Jones)

When the carbon footprint of fuel, fertiliser, herbicides and pesticides are factored in, plus erosion, water-quality decline and emissions of carbon dioxide, water vapour and nitrous oxide, conventionally produced soybeans (or other sources of non-animal protein) are less environmentally friendly than well-managed livestock grazing. Indeed, the fastest and most economical way to restore soils that have been degraded by conventional annual cropping systems is through the use of appropriately grazed perennial pastures.

The sooner the completely illogical 'eat vegan' and 'natural methane is a problem' issues are resolved, the better.

It is important to note however, that that not all beef has the same carbon footprint, or 'foodprint'.

The amount of energy required per unit of protein produced by grain finished beef is around twice that for pasture finished beef (8). This is due to the high energy requirements for fertiliser-intensive grain production coupled with transportation of both the feed and the livestock to the feedlot.

**Fig. 3.** Grass finished beef requires only half the energy per unit of protein than grain finished beef (8). (Photo Patrick Francis)

The gap between grass finished and grain finished widens even further when we take $CO_2$ production into account. Grass finished livestock merely recycle carbon (2, 9), as do all living things, including people. It is not possible for any animal to add 'new' carbon to the atmosphere. $CO_2$ emissions for grain-fed beef, however, can be high, due to the fossil fuel required for the production, distribution and application of synthetic fertilisers for grain production, loss of carbon from conventionally managed agricultural soils and transport.

There are also many compelling human health reasons for a return to pasture finished beef. Omega-3 and omega-6 fatty acids are regarded as 'essential fatty acids' because they cannot be manufactured by the body. It is important that these fatty acids be consumed in balance. Western diets high in cereal foods and/or vegetable oils such as sunflower, safflower, corn, soybean, peanut - and margarines and salad dressings made from these oils - often contain 10 to 20 times more omega-6 than omega-3, a trend that has been linked to increased risk of obesity, heart disease, dementia, depression, learning disorders, auto-immune diseases, diabetes, liver damage and cancer (10, 11). Fats high in omega-6 can promote tumour growth while fats high in omega-3 can block it.

The omega-3 fatty acid DHA occurs in significant levels in grass. Recent research has shown that grass finished beef has a more balanced omega-6 to omega-3 ratio than grain finished beef. This finding suggests that many of the health concerns associated with red meat consumption relate principally to grain finished beef. In addition to a better balance of omega fatty acids, grass fed beef has 3 to 5 times more conjugated linoleic acid (CLA) than grain fed beef. As little as 0.5% CLA in the diet has been shown to have powerful anti-cancer effects (12).

Omega fatty acids are well balanced in butter, cream and cheese. These high quality animal fats are indispensable to our physical and mental well-being. The brain, for example, is composed primarily of fat. Diets low in saturated fat can lead to depression and other mental disorders (10). Cholesterol, which is not a fat, but a sterol found in animal protein, is vital for the function of cell membranes.

Recent studies have linked low cholesterol levels with certain diseases and an increased risk of infection (10). Cholesterol is also important for inactivating heavy metals such as lead, mercury and cadmium.

**Conclusion**

A carbon friendly beef enterprise is more than possible. It is essential. Appropriately managed grazing is a potent tool for soil carbon sequestration, oxidisation of methane, improvement of nutrient cycles, enhancement of soil water-holding capacity, restoration of biodiversity, catchment health and landscape function. But above all, beef producers are food producers. Grass finished beef provides healthy, minerally dense food containing an excellent balance of essential fatty acids.

Angus Australia are to be congratulated on the launch of Angus Pure, pasture fed, hormone-free, antibiotic-free, quality beef. It is not only carbon friendly, but consumer friendly too.

***Source & references - Online Annex Issue #45***

*To read more by Dr. Christine Jones go to*
AmazingCarbon.com

# Homemade Health: Immune System Reboot

## By Marguerite Fly Bevis, RN, BSN

The old Creole saying, "prevention betta dan cure", is the answer to the question: how can we boost immunity? Our first thought is take vitamins and supplements and to figure out which ones are essential and why. Research reveals there are also other things we can do and ways we adapt our lifestyle to improve our chances of resisting illness.

In order to understand why we become sick we need to understand **oxidative stress**. The body produces free radicals during metabolism at a cellular level. Oxidative stress happens when the cells produce too many free radicals; it is associated with poor outcomes in all disease processes. Conditions such as Alzheimer's and Parkinson's disease, cancer, diabetes, high blood pressure, stroke, asthma, chronic fatigue, and other inflammatory disorders are associated with oxidative stress. Antioxidants (such as melatonin) counteract the free radicals. A diet rich in fruits and vegetables can also contribute antioxidants. Risk factors for oxidative stress are: diet high in unhealthy fat, sugar and processed food, obesity, smoking, alcohol, some medications, exposure to pesticides and other chemicals, exposure to radiation and pollution. Prevent oxidative stress by having balanced diet with lots of fruits and vegetables, limit intake of processed foods, exercise of some form regularly, reduce stress, avoid exposure to harsh chemical, stop smoking and get high quality sleep.

We have heard that we need ultraviolet light in sunshine to produce vitamin D3, which is involved in immune response. But our need for sunshine goes deeper than that. At night the body responds to darkness by producing melatonin which is an essential strong antioxidant that goes to work at the cellular level to clean up excess free radicals produced during metabolism at the cellular level. We may not be aware that during the day our bodies respond to non-visible infrared light which penetrates the cells and also produces melatonin. The circadian rhythm is a "master clock" that regulates the processes in our bodies and is affected by light. Like it or not, our bodies are "on the clock." Abnormal sleep patterns can affect melatonin production. The problem is, any exposure to light at night can stop production of melatonin which can lead to oxidative stress because free radicals are still being produced at the cellular level.

Another surprising link to a healthy immune system is not only the quantity of sleep but also the quality of sleep we get every day. In the book, "Sleep Smart" by Shawn Stevenson, the author states "high quality sleep fortifies your immune system, balances your hormones, boosts your metabolism, increases your physical energy and improves the function of your brain." Many of us are chronically sleep deprived. When we understand how valuable sleep is, hopefully we can make high quality sleep a priority in order to enjoy being and feeling our best. Research shows that after 24 hours of sleep deprivation there is a reduction in the amount of glucose that reaches the brain. Researchers have found that drowsy drivers are as dangerous as drunk drivers. It is evident that sleep deprivation adversely affects our ability to think and perform properly. Let's look at ways to improve sleep and achieve that high quality sleep we all need. Stevenson has some great tips for improving sleep. Taking what we now know about the effect light has on melatonin, he suggests turning off all lights and electronics by 9:00 PM. In the early evening begin dimming lights or switch to candle light. Put the phone away at least an hour before you plan to be asleep and maybe listen to music or audiobooks, something not stressful or anxiety provoking. Wind down with a warm bath and develop a sleep routine with a plan to go to sleep a few hours after the sun sets. Make your bedroom a dark sleep sanctuary. Remove ALL lights. The body senses light through the skin even if your eyes are shut or you have a sleep mask on. Try to avoid working where you sleep. Let your brain associate the bedroom only with sleep. Watch TV and work elsewhere. Keep room temperature as cool as possible. Avoid alcohol or caffeine before bedtime. If you work out, do it early in the day as that raises your core temperature; give yourself time to properly cool down and wind down before bedtime. In the morning go outside as soon as possible so your eyes can register sunlight. You need only a few minutes to help trigger the hormonal responses that give you energy. If you adjust your schedule to regularly rise with the light and sleep shortly after dark, you can improve your overall health and immune system. Learn to value sleep and make it a priority.

Another way to reboot our immune system is to try intermittent fasting which not only boosts immunity but also produces stem cells; can aid weight loss, control diabetes and prevent adverse health conditions such as inflammation; slows down aging; increases fat burning; improves mental concentration; increases brain function and energy; triggers autophagy (a cellular process where the body removes old cells and replaces them with new healthier cells); improves heart health; may prevent high risk of cancer; increases growth hormones; and improves gut health. Fasting rids the body of unwanted cells and old proteins, flushes away the bad and makes room for the good. Drinking lots of water during fasting enhances this benefit. "Hydration helps flush away dysfunctional cells and clears the gut of bad bacteria" says fcer.org.

"Fasting for just 24 hours boosts the regeneration of stem cells" says sciencealert.com. Stem cells are "super cells" that can replace just about every type of cell in the body during a healing event. "Researchers have found that healthier people tend to produce more stem cells than unhealthy people" says realnatural.org.

How to do intermittent fasting: In order to receive the benefits of stem cell regeneration and autophagy, consume only calorie and sugar free drinks, including water, black coffee and black tea until your designated window for eating, usually 1-4 hours a day. Choose the time that you feel the most hungry. There are many other ways to experience fasting so if you are interested, do some research and decide which method works best for you.

Supplements can be helpful to make sure we are getting the essential vitamins and minerals we need every day. We can get some of these in our food but it can be difficult to get them all and at the right dosage. Following are some recommended supplements to take daily. Magnesium is an essential mineral found throughout the body. Magnesium is involved in hundreds of reactions in the body including energy production, turning food into energy, protein formation from amino acids, help in the creation and repair of DNA and RNA, muscle movements, nervous system regulation, sending messages throughout the brain and nervous system. Magnesium may boost performance while exercising, may fight depression, may help normalize blood sugar levels, may promote heart health, boosts anti-inflammatory benefits, may help prevent migraine headaches, may help with symptoms of PMS, may promote bone health, may support better sleep, and reduce anxiety; it is known as the ultimate relaxer. Studies prove that magnesium normalizes the QT wave. A prolonged QT interval on the EKG is a risk factor for heart attack. Check with your doctor before taking supplements. Magnesium supplements may be unsafe for people taking diuretics, heart medications or antibiotics. Magnesium doses: ages 13+: 500

mg daily, children 6-12 years: 300 mg/day, 2-5 years: 200 mg/day according to Dr. Ardis. Healthline: 400-420 mg per day for men and 310 - 320 mg per day for women. Take before bed to help with sleep. If the dose causes loose stools back down on dosages until that no longer happens. An alternative to taking oral magnesium is to use it as an oil topically, or by soaking in Epsom's Salts baths.

Vitamin C, a powerful antioxidant is well known for its ability to boost immunity. It helps to prevent the buildup of free radicals that cause oxidative stress. Dr. Bryan Ardis recommends taking 10,000 mg daily divided into two or three doses. Most of us are not taking near that much so he recommends working up to it slowly.

Selenium increases antioxidant capabilities and the quality of blood flow. Selenium is a component of the antioxidant enzymes, glutathione reductase, and is key for wound healing throughout the body; it acts as an antioxidant and defends against oxidative stress and inflammation, may help defend against cancer, can help boost immunity, may lower risk for heart disease, regulates thyroid function, increases longevity, reduces asthma symptoms, and can help boost fertility. Recommended dose for selenium is 200 mcg for adults.

Zinc affects hormones, sex drive, reproductive cycles, immunity, and metabolism; it can significantly boost immunity, help you fall asleep faster and stay asleep longer, lose weight faster, boost hormone health, sex drive and performance (men and women). Zinc protects the liver against carcinogens and toxins and can even transform your gums and teeth (stop bleeding, decay and keep them whiter). Zinc deficiency is experienced by over 1.1 billion people in the world. Dosage according to the USDA: children 1-3: 20 mcg/day; children 4-8: 30 mcg/day; children 9-13: 40 mcg/day; adults and children 14 + 55: mcg/day; pregnant women: 50 mcg/day; breastfeeding women: 70 mcg/day.

Iron is a trace mineral found in every cell of our bodies. It is a component of the protein hemoglobin which is the part of the red blood cell that carries oxygen. Anemia is caused by decreased production of red blood cells. Iron supports immune function and energy levels, supports development and growth, affects mood and helps with cognitive ability. According to the US Office of Disease Prevention and Health Promotion, the recommended daily dosage of iron are: infants under 12 months: 11 mg; children ages 1-4: 7 mg; adults and children over 4: 18 mg; pregnant and breastfeeding women: 27 mg.

Vitamin E fights free radicals preventing disease development, improves vision, balances hormones, repairs damaged skin, thickens hair, helps with Alzheimer's, improves muscle strength and is important during pregnancy. Recommended daily dose of vitamin E is no more than 15 mg for adults; 11 mg for teens; and 7 mg for children.

Vitamin B6 converts food into energy; boosts immunity; benefits the brain, eyes, and heart; and produces red blood cells. Effects of low vitamin B6 are brain fog, low energy, and difficulty concentrating.

Vitamin D3 is a vitamin that is produced by the skin when exposed to sunlight (ultraviolet rays). It supports the immune system, heart and bone health and can support cognitive health and mood. Recommended dose is 1.3 mg daily for adults 50 and younger; for 50+ the dosage is 1.5 mg for women and 1.7 mg for men according to the Mayo Clinic.

Probiotics are "good" bacteria in the digestive system that feed and help probiotics survive and reproduce. 95 % of the body's serotonin, the "feel good" hormone, is produced in the gastrointestinal system. "More than 70 percent of your immune system resides in your gut" says Dr. Axe.

In addition to supplements, we also need exercise. Volumes have been written on the value of exercise. The body needs to move and movement helps keep us healthy, maintains weight and muscle tone and helps regulate hormones. Find something that you enjoy and do it. Just move.

Finally, in order to boost your immune system, eat real food. This may seem simple and it is. Fruits and vegetables provide essential antioxidants in the form of vitamins and minerals. To prevent oxidative stress, consume a balanced diet with lots of colorful fruits and vegetables, limit intake of processed foods and unhealthy fats, get regular exercise, reduce stress, avoid exposure to harsh chemicals, and stop smoking.

Foods containing magnesium: pumpkin seeds, chia seeds, boiled spinach, almonds, cashews, cooked black beans, cooked edamame, peanut butter, cooked brown rice, salmon, halibut and avocados.

Foods containing vitamin C: acerola cherries, tangerines, lemons, yucca root/cassava.

Foods containing zinc: Animal products are better than plant sources because of their bioavailability (portion of zinc that is retained and used by the body). Plants have high amounts of physic acid which inhibits absorption of zinc. Some foods that will provide zinc are lamb, pumpkin seeds, grass-fed beef, garbanzo beans, cocoa powder, cashews, lentils, kefir or yoghurt, mushrooms, spinach, ricotta cheese, chicken, almonds and avocados.

***Continues on page 27***

# Successful Papaya Growing
## By Dr. Sophia Clarke

Based on conversations with Cergio Mai (BAHA Plant Health) and Rene Tzib (certified pesticide-free farmer) and the book *Fruits of Warm Climates,* by J.Morton.

As we all know papaya is delicious, commands a good sale price, and has many excellent nutritional and medicinal properties. Growing organically is much the better for health, but as I was warned by Cergio Mai of BAHA Plant Health, "this will be a challenge!" due to the fact that papaya is susceptible to many diseases and pests. I can testify to that as we have found on our farm in Cayo. So I wanted to find out how we could be more successful growers of papaya.

This article is about *Carica papaya*, the specie that is grown in Belize. In Australia and some parts of the Caribbean papaya is known as pawpaw but in his book, *Fruits of Warm Climates,* J. Morton says pawpaw is better suited to very different, mainly wild *Asimina triloba Dunal*, which belongs to the family Annonaceae. Papaya is native to both southern Mexico and neighboring Central American countries.

**Papaya Flowers**

***the open flower is hermaphrodite and the unopened one is female***

This is complicated! Papaya plants grow in three sexes: male, female, and hermaphrodite (whose flowers contain both male stamens and female ovaries). But there may even be plants with both male and female flowers. Others at certain times of the year produce male flowers, but at other times, hermaphrodite flowers. This change of sex may occur temporarily during high temperatures. In addition, male or hermaphrodite plants may change completely to female plants after being beheaded. The male plant has flowers which are clustered, growing at the end of long branching stalks. The buds are thin and shaped like an elongated spoon. They have bright orange anthers. The female flowers on the other hand, are considerably larger and fatter, on very short stalks. They are puffed out by a fat ovary and branching yellow stigma, where the pollen from a male or hermaphrodite lands. The hermaphrodite flower is thinner than the female flower, having a tubular shape. It has orange male anthers, and also a cylindrical ovary, but with no branching on top. The male produces only pollen, never fruit; the female produces small, inedible fruits unless pollinated by wind or insects. The fruits from female flowers are round or oval, and thin-walled. The hermaphrodite flower, however, is able to self-pollinate. The fruits from these are usually cylindrical or pyriform, with a small seed cavity and a thick wall of firm flesh which withstands handling well. See what I mean about being complicated?

Almost all commercial papaya orchards contain only hermaphrodites. BAHA Plant Health advise planting out only hermaphrodites.

**Cultivars**

Two kinds of papaya are commonly grown. One has sweet red or orange flesh; the other, yellow flesh. Large red fleshed "Maradol", Maradona", "Sunrise" and "Caribbean Red" are commonly grown in Mexico and Belize. In Orange Walk, the papaya exporters favor the Tainung variety.

**Diseases and Pests Affecting Papaya in Belize.**

- Papaya mosaic virus
- Papaya ringspot virus (PRSV)
- Papaya Meleira virus
- Bunchy top disease (involves a bacterium belonging to the genus *Rickettsia*, and most likely the vector is the leafhopper *Empoasca papayae* )
- Anthracnose (a group of fungal diseases)
- Phytophthora (these resemble fungi but in fact they are not. They are most often referred to as water molds.)
- Mealy bugs
- Snails
- White flies
- Leaf hoppers
- Aphids
- Mites

**Seeds**

Papaya are generally grown from seed. You need to start with certified seeds in order to grow healthy papaya. There is no hybrid papaya seed that is 100% hermaphrodite; generally the range is 50-90%. East West Seeds in Benque sells hybrid and non-GM seeds; the agent sells only in bulk. Agric-Pric in Cayo also sells papaya seeds. A recommended seed is the Tainung cultivar, developed in Taiwan, which ranked highest in extensive trials in Orange Walk. It has an excellent brix number (sweetness); it is less hollow than other varieties and fares well on handling. Certified Tainung seeds may be available in bulk from the papaya exporter in Indian Creek, in Orange Walk. Papaya tolerant to bunchy top disease have been found and bred, but production is limited to areas with a low disease pressure.

**Saving Your Own Non-GMO Papaya Seeds**

Interestingly enough, you can obtain your own true-to-type seeds from hermaphrodite plants grown from F1 certified seeds. This is done by (1) selecting the best trees which are healthy, (2) carefully covering unopened flowers with paper bags (stamp collectors semi-transparent envelopes are ideal), (3) stapling the ends closed to prevent other pollen getting in, and (4) marking with a tag the point where the bud attaches to the tree, as the bag will burst as the fruit grows.

Harvest the fruit at the color break stage, and collect the seed from the fruit. The plants from these seeds should then grow true to type and be vigorous because the hermaphrodite flower can self- pollinate, so the seeds are replicas of the parent. The seeds should be dried to moisture levels of 9-12% for long term storage, as seeds harvested fresh can have variable germination.

**Germination**

Firstly remove the gelatinous layer by rubbing. Place on wet paper or blanket, cover and leave to germinate. An alternative protocol is to soak the seeds in a container filled with clean water for 48 hours. They should be completely covered with water. Change the water every 8 hours. After 36 hours, remove the seeds that float. East West Seeds recommends that during the last 8 hours of soaking, you should add 1/4 teaspoon (1.25 ml) of gibberelic acid per 4 1/4 cups (1 l) of water. This is a natural product extracted from the *Gibberella fujikuroi* fungus that is found on rice plants. (However, other growers say adding gibberellic acid is not necessary.) It is advised to keep the seed for two days between two cotton sheets (boiled and disinfected) while keeping the humidity constant to avoid dehydration.

Sow the seeds in seedling trays at a depth of 1/2 inch (12.7 mm) against sun, wind and rain i.e. in protected structures. Regulate the humidity well to avoid root rot and fungal attacks.

**Preparing the Soil**

Papaya generally do poorly on land previously planted with papaya, a result of soil infestation by *Pythium aphanidermatum* (a water mold which causes damping off of seeds and seedlings, and root rot) and *Phytophthora palmivora*. Root rot of papaya seedlings, caused by *P. palmivora*, in replant fields can be controlled with the virgin soil technique. Virgin soil (soil in which papaya has never been grown in before) is placed in planting holes about 12 inches (30.5 cm) in diameter and 4 inches (10.2 cm)deep, with a mound about 1.5 inches (3.8 cm) high. Roots of papaya plants are protected by the virgin soil during the susceptible stage, and become resistant to the pathogen when they extend to the infested soil.

**Planting Out**

Plant out from 6 weeks onwards (up to 6 months). The site must be free of volunteer papaya and host plants, especially in respect of viral diseases. Raised beds and properly drained land are ideal for the prevention of Phythophora. It is important to do soil sampling of your intended sites prior to planting to determine the fertility and availability of nutrients, so that organic inputs can be customized.

Plant 6 seedlings per site, and then sex the plants at flowering. Due to being a dominant trait, hermaphrodites are the most common sex, followed by females and lastly males. It is best to plant 7 feet (2.2 m) apart, and 12 feet (3.6 m) between rows; about 3,000 plants per acre (1200 per hectare). The best time of year to plant out is from May onwards excepting December. The issue is slow yields in certain months.

**Disease and Pest Control Treatments**

The treatments should be Integrated Pest Management (IPM) based. The following are useful:

- The use of plant barriers: sunflowers and sugar cane.
- Weed control.
- Colored insect traps; sticky insect traps.
- Diatomaceous earth, sprinkled around the plants. Reapply after rains.
- Neem.
- EM 0.5 (effective micro-organisms with neem); and EM Agriculture, a concentrated mother culture of naturally occurring beneficial micro-organisms for growing plants.
- For viruses in general: "roguing": identifying and clearing out of diseased and undesirable plants, once a field is infected. This means that the control of pests that transmit them is crucial.
- The cleaning of equipment and tools.
- For bunchy top disease: in addition to measures to combat leafhopper vectors; removal of infected treetops at a point below where the latex flows freely on wounding can result in healthy shoots from the trunk.
- Large net houses (as in Taiwan) to keep out disease-carrying non–persistent aphid vectors.

The following biological control agents (with the possible exception of Metarhizium) are difficult to source in Belize and in any case, usage should be guided by an entomologist.

- Metarhizium (a fungus in spore form which is a natural pesticide against locusts)
- *Chysopa spp*. (green lacewing insects; their larvae feed on aphids.)
- Timorex Gold (an **organic** fungicide based on a plant extract)
- Mealybug destroyer (*Cryptolaemus montrouzieri*, a ladybird species, which is a biological control against mealybugs and other scale insects)
- *Beauveria bassiana* (a fungus which protects against insect pests)
- Parasitic wasps

**Harvesting**

Studies in Hawaii have shown that flavor is at its peak when the skin is 80% colored. However, for shipment, the first indication of color is permissible. The fruits must be handled with great care to avoid scratching and subsequent leaking of latex which would stain the fruit skin. Home growers can twist the fruit to break the stem, but commercial operations prefer the use of a sharp knife to cut the stem. The fruits are best packed in single layers and padded to avoid bruising.

**Growing Papaya in San Antonio**

Rene Tzib, pesticide-free farmer in San Antonio, grows hybrid papaya successfully from F1 certified seed. His regime is:

- Plant seedlings out at 3 months, then sex the plants at flowering at 4 months. Plant out only 5 male plants out of 100.
- Phyton to protect against fungus: use it as you plant out; then spray the leaves and soil every 4 weeks.
- EM Agriculture: apply when planting in a hole, then again every two weeks.
- Sulphate (or cow or pig manure) and white marl mixture: use for preparing seedlings against fungus and ants; spray plant tops every month.
- White lime: mix with water and put in the hole when planting; this counteracts ants and worms.

**Pruning**

After fruiting at 6 months, Rene cuts the big branches, and then the smaller branches give a second crop. The plant dies at around 1 year 6 months.

***Editor's Note: Dr. Sophia Clarke is a retired physician; she lives with her husband, Robin, on a farm in San Antonio, Cayo. Both serve on the board of directors of Pro-Organic Belize.***

For nutrition and recipes on papaya see www.pro-organicbelize.org which also has reference to many other fruits and vegetables of Belize in the *Tropical Garden Guide* there.

# Agave: The Century Plant of Belize

## By Michael Richardson

The landmark ornamental Agave americana, commonly known as the "century plant" has been in Belize for centuries. Known as maguey in Mexico, the hardy succulent is native to hot, arid regions of the Americas. Agave is a genus of monocots with dozens of species. Although often misidentified as a perennial, the century plant is actually a monocarpic (meaning that each rosette dies after flowering and fruiting) multiannual since each spined rosette flowers only once with a thirty-foot bloom mast or quiote and then dies. The tall mast protects the young flowers from predation by insects or animals.

Archaeologists working at Caracol have confirmed the ancient Maya used agave fibers in textile manufacture although the long passage of time leaves little evidence of the extent of agave use in pre-historic Belize.

A. americana was introduced into southern Europe about the middle of the 16th century, and is now naturalized as well as widely cultivated as an ornamental plant. The genus Agave was established by botanist Carl Linnaeus in 1753, initially with four species. Agaves and close relatives have long presented significant taxonomic difficulty. Agaves are frequently confused with cacti and aloes but are in a different plant family. Agave was first placed in the family Liliaceae; however phylogenetic analyses of DNA later showed it did not belong there. Agaves were subsumed into the expanded family Asparagaceae, and was treated as one of 18 genera in the subfamily Agavoideae. Horticulturists have bred a number of varieties compounding the difficulty of proper identification. For a long time the number of Agave species was considered to be 166 varieties. Modern classification now lists 252 species.

The traveller William Prescott encountered agave plants in Mexico in 1843. "But the miracle of nature was the great Mexican aloe, or maguey, whose clustering pyramids of flowers, towering above their dark coronals of leaves, were seen sprinkled over many a broad acre of the table-land. As we have already noticed its bruised leaves afforded a paste from which paper was manufactured, its juice was fermented into an intoxicating beverage, pulque, of which the natives, to this day, are extremely fond; its leaves further supplied an impenetrable thatch for the more humble dwellings; thread, of which coarse stuffs were made, and strong cords, were drawn from its tough and twisted fibers; pins and needles were made from the thorns at the extremity of its leaves; and the root, when properly cooked, was converted into a palatable and nutritious food."

Agave tequilana and A. azul are the varieties used in the production of tequila. In 2001, the Mexican government and European Union agreed upon the classification of tequila and its categories. All 100% blue agave tequila must be made from the A. tequilana 'Weber's Blue' agave plant, to rigorous specifications and only in certain Mexican states. Distilled agave produces mezcal from which tequila is refined.

The agave plant needs almost no care and can survive on very little water. The strong, fleshy, sword-shaped succulent leaves have sharp marginal teeth, an extremely sharp terminal spine and are very fibrous and tough. The stout stem is short, which makes the plant appear as though it is a ball of spikes and stemless. Gardeners who must work around agave plants may consider nipping the ends of the spines to prevent injury from the sharp points. There are accounts from old Belize that the tips with attached spine fibers were used as needle and thread to sew up baskets, etc.

Relatively fast growing until it reaches six to eight feet, the agave then seems dormant for years until it flowers "once a century" as the folk tales go. A common lifespan cited is thirty years before flowering although environmental conditions seem to influence maturity. The agave is considered mature for harvest after seven years. The majestic flower mast grows out of the center of the spike array and bears a large number of small, tubular greenish flowers which become bulbils or small agave plants. The century plant also reproduces with rhizomatous suckers or pups which develop from the root of the parent rosette.

Agaves ready for harvest have to be mature and just starting to bloom. The inflorescence must be cut before it starts growing. The plant remains in its place for some months up to a year. That wait allows the agave to accumulate sugars and water in the centre of the crop. These sugars come from the leaves and were meant for the growth of flowers and nectar. The leaves or stalks are then cut and just the "head" is left which looks like a pineapple. For this reason it is called agave head or agave pineapple. This process is done manually. The agave heads are baked, its juice is fermented and then it is distilled.

The agave root system consists of a network of shallow rhizomes which capture water from rain, dew, and condensation. The tough, waxy coated leaves, which are imperious to insect or animal attack, store the plant's water supply making it a robust contender during droughts and dry seasons. The plant is a climate change survivor and needs little care beyond the work of harvest. Although parts of Belize are too wet the agave thrives in well-drained soil.

Today, agaves are used mainly for the production of syrup and sugar. The sap called aguamie in Spanish, meaning "honey water" (commonly called agave nectar), is used as an

alternative to sugar in cooking. Agave sweetener is marketed as natural and diabetic-friendly, without spiking blood sugar levels. Both market demand and prices are high in Mexico, the world's largest agave producer.

Approximately 88 million mature agave plants were harvested in 2020. The harvest increased to 126 million in 2021, and as many as 150 million are expected to be harvested in 2022. There are 500 million plants currently under cultivation in Mexico.

Agaves are not commercially grown in Belize, but could be grown in the drier areas and on marginal land without other production alternatives. World demand continues to rise for agave as a sweetener of choice making it a high value crop. It is time for Belize to cash in on the century plant.



### *Homemade Health...Continued from page 23*

Foods containing iron: spirulina, liver, dark chocolate, pumpkin seeds, black beans, lentils, grass-fed beef, pistachios, chickpeas, sardines, eggs, kale and chicken.

Foods containing vitamin E: almonds, sunflower seeds, mangos, broccoli, spinach, avocados, and tomatoes.

Foods containing vitamin B6: beef liver, chicken, turkey, salmon, tuna, chickpeas, acorn squash, potatoes, black-eyed peas, onions, chestnuts, pistachios, butternut squash, avocados, watermelon, bananas, cottage cheese, apricots, and grapes.

Foods containing vitamin D3: egg yolks, liver, fatty fish, and mushrooms.

Foods containing probiotics: fermented food such as pickles pickled in salt solution, sauerkraut, kefir, yoghurt, kimchi, kombucha, kvass, and apple cider vinegar (with the mother).

Think of your food as medicine and eat accordingly. Your health, your vitality, and immune system are riding on the daily decisions you make on what you put into your body. You don't have to feel helpless when it comes to illness. Prevention is better than cure.

***Sources:***


*TruthforHealth.org*

*newregenortho.com*

*sciencealert.com*

*realnatural.org*

*fcer.org*

*drardisshow.com*

*mayoclinic.org*

*"Delay, Don't Deny, Living an Intermittent Fasting Lifestyle" by Gin Stephens and Dr. Kenneth Power*

*Dr. Axe: Selenium, zinc,*

*"Sleep Smarter" by Shawn Stevenson*

*"Eat Smarter" by Shawn Stevenson*


***Disclaimer:*** *The purpose of this column is to share useful information about health that is relatively inexpensive and generally readily available for everyone. The information is not meant to be a substitute for health care, i.e., regular visits to a healthcare provider and as necessary when you are ill. Please see your doctor before trying any new supplements or therapy.*

# Easy Greens to Grow in Belize

By Dr. Mandy Tsang, Toledo, Belize.

It has been about 10 years since I last wrote an article for the Belize Ag Report. Just to fill you in on my background: my husband and I are both medical doctors who came to Belize 18 years ago. We wanted to grow our own food with our own hands and dig in the dirt. In short, we have become sustenance farmers. I understand that many people would not put themselves into a position of trying to survive solely on what they grow. However, it is important to point out that sometimes the world can change in many unexpected ways and we should have some contingency plans. For example, during the start of the COVID-19 lock-down, the Punta Gorda vegetable market was closed for weeks. Many people had no access to vegetables or fruit. Surely these types of scenarios should prompt us to have some type of vegetable garden in our backyard, porch, or if you really don't have the space, a few pig tail buckets!

This article highlights a few leafy green vegetables that anyone can grow with no knowledge of gardening required. And why the emphasis on green leafy vegetables? These contain vitamins and minerals which are essential to health; leafy vegetables are low in calories, high in protein and contain vitamin C, pro-vitamin A, carotenoids, folate, manganese and vitamin K which are essential for normal cell function. Nowadays, this part of the diet can be sadly neglected because a lot of packaged food (e.g., bread, biscuits, etc.) are fortified with vitamins. Yes, there are arguments on both sides and we are well aware that we have overcome a lot of diseases related to vitamin deficiencies because of this addition. However, because of this fortification, many people can get away with eating no vegetables at all! Indeed, I think it is better to equip people with sound nutritional knowledge so they are able to make educated choices.

The first green that I would recommend is chaya (*Cnidoscolus aconitifolius*); it grows all year round and requires no maintenance.


Chaya

This plant is propagated by stem cuttings; it is so easy; take a chaya stick about 2 feet long and stick it into the ground about 6 inches deep. You don't need to prepare the ground with hoeing or tilling. It is so hardy that that it grows even in the hard, clay soils that are common in the Toledo district. You can even stick a stem into a 5 gallon pig tail bucket. I have planted the stem in wet boggy areas with no problems. Also, it is a drought tolerant plant that can survive through dry season with not a single drop of rain, a "back up" plant when other vegetable crops fail or when irrigation is limited during dry season. Although it does not die back, lasting year after year, it is worth re-planting every five years for more succulent leaves. It is productive; picking the leaves encourages new growth.

I have not seen any pests or leaf infestations on chaya. Generally speaking, if you grow your own greens or vegetables, you may be constantly battling all manner of caterpillars and bugs which leave your lovely succulent greens riddled with holes. Raw chaya leaves contain hydrocyanic acid; general (Wikipedia) information states that you can still ingest up to 5 raw leaves daily without any toxic effects but recommends a cooking time of 20 minutes. It is important to pick a cultivar which is known to contain low amounts of the hydrocyanic acid to reduce the cooking time required. Having said that, I still cook chaya for this prolonged length of time to soften the leaf to aid digestibility.

Chaya is remarkably good for you and contains 2 to 3 times higher levels of vitamins and minerals than other green leafy vegetables. It is high in protein, calcium, iron and vitamin A. With regards to preparation, harvest the younger leaves (although older leaves are fine too but less succulent and tougher so require longer cooking time); wash and chop, shred or even blend into small pieces. Cook in soups, stir fries, stews or whatever you like to eat. Some novel suggestions are chaya curry, chaya lasagna, or beef/pork and chaya stir fry. We actually use chaya as an alternative to traditional spinach to make green pasta sheets. Apparently some Belizeans cook finely chopped chaya in scrambled eggs.

Moving along to the next easy green, I recommend moringa (*Moringa oliefera*); it is another one that you can plant by sticking


Moringa

a cutting into the ground. However, this plant does not grow well when its roots are in standing water so I suggest that you plant moringa in high and dry areas. For years we were unable to cultivate moringa on our farm because it was too wet and boggy. With some experimentation, we found that they grow well in tyres, usually 2 or 3 tyres high to protect the roots from water logging. Again, I have not seen any pest or infestation problems with this plant.

Many parts of the moringa are edible including the flowers, immature seed pods and seeds. For the purposes of this article, I concentrate on the greens since this is the topic at hand. The greens of the moringa are the most nutritious part of the plant containing high levels of the following: B vitamins, vitamin C, provitamin A, vitamin K, manganese and protein. Note that to get the nutritional benefits, you still need to eat a considerable amount of the leaves in one meal. You have to gather at least 5 cups of these leaves to get recommended levels. That is no mean feat because the leaves are very small and harvesting may become labour intensive. From my own experience, it is practical enough

to gather a cupful of moringa leaves per person. It won't provide all the nutrients that you need so you should cook it with the addition of other greens and vegetables. To prepare, gather the leaves and remove from stalks which are fibrous. After washing, they can be eaten raw in salads or used as a condiment to a dish. Otherwise, if you want to cook it, put into soups, stews or stir fries. When raw, it has a very, very mild horse radish taste. When cooked, it tastes like any other green. You can of course dry the leaves if you want but I have found this to be very impractical and time consuming. It makes sense just to eat it fresh since it is available all year round.

The third easy growing green is Malabar spinach (*Basella alba*). This green leafy vegetable is a rich source of vitamin A, vitamin C, B vitamins, folate and manganese. This spinach can be grown from cutting or very easily from seed. It is a naturally sprawling plant that can be grown on the ground or on beds. It can also be trained up sticks if you want to keep it off the ground. It thrives on water/rain and can be planted in boggy areas. Unfortunately, it is a succulent tasting plant so it is prone to caterpillar infestations, white fly and assassin bugs; so it does require more maintenance and care than other greens. Nevertheless, once it has established healthy growth, it does very well and tends to take over the place. Note that this plant does die back in winter time in Belize so you cannot rely solely on having this green all year round. The leaves and stem are edible; it can be eaten raw in salads and can be cooked like a spinach. The leaves are mucilaginous -a bit like that sliminess that you get with cooked okra; this can be easily overcome by cooking the vegetable on high heat (boil or stir fry) for about 5 to 6 minutes. The slimy texture remains if only steamed for 1 to 2 minutes. If eaten raw, this property is generally not noticed because it is the heat that breaks up the tissue and releases this substance. This vegetable has been cultivated and integrated into many cultures including Indian, Filipino, African and Chinese cuisine so you can probably find some authentic recipes on the Internet. Otherwise, you just cook it like you would cook spinach.


Malabar spinach

It is my hope that this article encourages you to grow your own greens, eat them all year round and recognize the health benefits of eating freshly picked greens from your own backyard. Go on... you know you want to...it will only take 2 seconds...go and plant a stick in the ground and you will have greens in a few weeks!! *Eat your own greens*!!

*"Have nothing to do with having nothing to do."*

# Ta'nah Farmers Group

## By Beth Roberson

In March of 2021, a group of experienced and determined farmers of San Antonio, Cayo District*, began meeting together every 2 weeks, with the aim of working in coordination with each other to increase productivity and profitability for their individual farms. Their efforts were rewarded when on 8 September 2021, the Ta'nah Farmers Group, comprised of 25 men and women farmers, was officially registered and recognized as an association.

Ta'nah Farmers Group attributes its name to the Yucateca Maya word, *ta'nah,* meaning 'a home, a hometown, or my place, my home'. The group's goals include increasing food security for their community, via continuation of farming, and improvement and expansion of their already strong agricultural base.

**San Antonio is Belize's peanut capital but so much more than that.**

San Antonio has been known since the 1960's for its peanut production; the rich black soil and growing conditions fit peanut's agronomic needs perfectly. About 200,000 lbs. are grown annually in the greater San Antonio area, all consumed domestically. Peanuts store well, for up to a year, and without costly drying equipment as many staple crops require. Typically, most farmers plant in either late May or June (depending on first rains), and harvesting falls in September (for June planting). A well fertilized field can yield 1,500 lbs./acre. Drying losses are about 10-15%. At harvest time prices are the lowest, as low as $1.00/lb.; prices this year have ranged after the initial harvest time, from $1.50 – 2.00/lb. for bulk sales (over 100 lbs.), with current prices about $2./lb.

Pending exportation in fall of this year of Ta'nah's upcoming 2022 summer peanut crop to El Salvador should improve Ta'nah members' bottom lines substantially, with prices to the farmers per lb. almost doubling. The first shipment that Salvadoran buyers have ordered is for a container of 20,000 lbs., with potential to purchase double that amount monthly if available. This will be a drastic change for the better for all peanut farmers, Ta'nah members and others, as the group will want to discuss purchase from non-members also. Some of the reasons why these peanuts are so desirable to the buyers is that they are not only organically and regeneratively grown without pesticides, but they are also harvested by hand, rendering them premium peanuts.

Ta'nah members' products currently are about 40% peanuts, 40% vegetables (notably carrots & cabbage), 10% other crops (including corn, beans, yucca & macal), and 10% livestock (cattle, chickens, pigs & tilapia). Given time, their plans are to export several of these also. Meanwhile, they are holding and sourcing training for their group; especially in

***Continues on page 34***

***Part 2 of Belize Ag Report's Flour Series***

# New Opportunity for an Alternative to Wheat: Sorghum, aka Milo and Maecillo

## By Maruja Vargas

Sorghum, (*Sorghum bicolor*) is an ancient grain better known as milo in Belize and maecillo in Latin America. It has been cultivated for 5,000 years and is one of the five principal grain staples of the world. Over 500 million people in 30 countries rely on sorghum as their main grain staple. Sorghum is among the most efficient crops in the conversion of solar energy and is very drought tolerant, requiring only 6 inches of annual rainfall which is 30% less water than other grains. Sorghum adapts well to both mechanized commercial farming and to small scale cultivation methods.

Sorghum's 100% whole grain kernel can be ground to produce a flour that is sweet, softly textured and mild tasting. Sorghum flour is gluten free, high in fiber and has a low glycemic index, a robust nutritional profile (12% protein, iron, B6, niacin, magnesium, and phosphorus), high antioxidant activity and pH stability three to four times greater than other grains. One cup of sorghum cereal provides 20 grams of protein. Due to the softness of the whole grain, the nutritional values far exceed those of bread made from bleached white flour. Tortillas, quick breads, pastries, cakes, biscuits, and cookies can all be successfully made with milo flour. The carbohydrates in breads made from milo are digested more slowly than other carbs, which helps balance blood sugar levels, minimizing peaks and drops. Milled milo can also be cooked as a hot cereal and the whole grains 'popped' like popcorn – rivaling maize in its versatility.

From a cost perspective, it would be much cheaper to make bread and tortillas (see recipe below) from milo or a combination of milo with other locally produced grains than solely with imported wheat flour. Both the Spanish Lookout community in Cayo and the Blue Creek community in Orange Walk raise milo, primarily for use in animal feeds. In 2021 Spanish Lookout harvested over 1,400 acres of milo, mainly grown as a winter crop. Local bulk prices have averaged around $0.21/per lb. Currently in Belize City, a 22 oz. package of imported "whole-grain non-GMO stone ground sorghum flour" costs $8.20 + GST = $9.23, or $6.71 BzD per pound. Quality Feed Mill in Spanish Lookout sells the whole grain milo, retail at $0.34 /lb. See the cover photo; the lighter colored whole grain milo is imported and the darker whole grain is the local. The lighter colored varieties are used in Latin America for tortillas, baking, etc.; the darker local variety is processed here into chicken and other animal feeds. There is a multitude of varieties; the tan, white and colored are typically used for flour. Although the dark red/purple and black varieties contain more anti-oxidants and anthocyanins, they are used less often for flour.

Former Belize MAFSE Chief Agricultural Officer, Mr.Waight, stated in 2008, "CARICOM is looking to Belize as a potential source to help fill flour demands in Caribbean countries." Might Belize become an exporter rather than an importer of flour, contributing to the food security of the entire Caribbean?

***Continues on page 34***

## SPANISH LOOKOUT COMMUNITY CROP STATISTICS for the year 2020 - 2021

| Animal Type | End of 2020 | End of 2021 |
|---|---|---|
| Dairy Cattle | 2,242 | 2,205 |
| Beef Cattle | 21,627 | 21,687 |
| Layer Hens | 210,691 | 192,651 |
| Breeders | 62,610 | 67,660 |
| Pullets under 5 month | 34,063 | 46,261 |
| Broiler | 962,248 | 948,200 |
| Horse | 246 | 269 |
| Hogs | 2,619 | 2,838 |
| Sheep | 454 | 396 |
| Goats | 454 | 60 |

| Grain Type | Acres 2020 | Bags 2020 | Acres 2021 | Bags 2021 |
|---|---|---|---|---|
| Yellow Corn, Summer | 23,652 | 1,046,932 | 26,800 | 1,597,425 |
| Yellow Corn, Winter | 2,634 | 113,139 | 1,004 | 43,943 |
| Corn for Silage | 204 | - | 338 | - |
| White Corn, Summer | 1,378 | 60,896 | 1,057 | 57,007 |
| White Corn, Winter | 1,757 | 74,605 | 1,080 | 34,230 |
| Milo, Summer | 59 | 1,429 | - | - |
| Milo, Winter | 2,805 | 107,433 | 1,402 | 43,628 |
| Red Kidney Beans | 5,057 | 41,095 | 6,972 | 61,665 |
| Blackeye Peas | 5,794 | 51,591 | 7,438 | 35,667 |
| Soy Beans | 8,328 | 149,480 | 7,607 | 106,032 |
| Rice | 2,924 | 113,879 | 2,535 | 121,172 |
| Other Crops | 435 | 1,665 | 881 | 5,243 |

## The 7th Spanish Lookout Industrial / Commercial Expo

was held on 26th and 27th March 2022. There were 180 booths from all over Belize. Next Expo: 2024












*Photos courtesy of Dynelle Marie Photography*

# AG BRIEFS

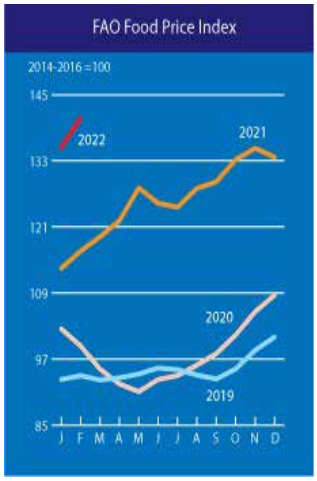
**National Agriculture and Trade Show 27th, 28th & 29th May 2022, Contact: Gary Ramirez Chair of NATS Commitee, NATS Grounds, Belmopan, Ph: 822-2648 or 623-0606, Email: nats@agriculture.gov.bz**

**Pro-Organic Belize announces its speakers list** for spring-summer: Visit pro-organicbelize.org for link information.

**7th May** - Dr. Ed Boles: *More Belize Landscape at Risk to Exploitation by Multi-national Company*
**4th June** - To Be Announced
**2nd July** - Libby Vidrine & Jim Rabon: *Grow and Cook with Spices and Herbs*
**6th August** - To Be Announced
**3rd September** - Dr. Thomas Mathew: *Making Lemongrass Oil*

**Fundraiser Yard Sale at Hode's: May 14, 9:00 -12:00**, Sponsored by Pro-Organic Belize. Bring seeds, plants, household items to Robyn Cruz Phone: 628-1770

The Food and Agriculture Organization of the United Nations reported in February that the international food price index hit an all-time high in February. Food prices are up 24% from one year ago. And it's only going to get worse.




Local cheesemaker, Chris Harris of White Rock Farm, Cayo District, was lauded in an international cheesemaking site: https://blog.cheesemaking.com/chris-harris-in-springfield-belize/

*Environmental Science and Pollution Research*, released the results from a countrywide glyphosate testing campaign in France. Glyphosate was classified as a "probable human carcinogen' by the IARC in 2015. Samples of 6,848 people from 83 municipalities were collected between June 2018 and January 2020 and sent to a third party laboratory in Germany. The lab detected glyphosate in 99.8% of the samples, at "an average level of 1.19 µg/L (ppb)". Farmers, especially those working in a wine-growing region, showed higher levels.

Spanish Lookout's Quality Feed Mill broke ground for a soybean oil refinery on 30th March. They anticipate supplying up to 3.5 million liters annually for the domestic cooking oil market, lessening dependence on imports.

US fertilizer prices rose 17% in 2021 and are expected to rise 12% in 2022 (American Farm Bureau Fed & USDA). Liquid nitrogen fertilizer in the US rose 232% above 2021's price. These data may lead some farmers to switch to crops which need fewer nutrients, or just use less fertilizer. Russia and Belarus last year supplied exports of the following: over 40% of global potash; 22% of global ammonia; 14% of global urea and 14% of global MAP.

World wheat situation: Last year, Russia and Ukraine together supplied approximately 30% of global wheat exports and 20% of global corn exports. India is also a top global wheat producer and exporter, being the 2nd largest exporter, after China in 1st place. In 2021-2022 India exported 8.5 million tons and they estimate to have the potential to export 12 million tons in 2022-2023 year. India's state-run warehouses held more than 23 million tons of wheat in early March, which is 3x the level required by the Indian government. Droughts in many locations, such as the US & Canada, have driven prices to the highest on record. CBOT prices shot to US$13.635/bushel after the Russian intervention in Ukraine. Prior to that, the 5 yr. average CBOT price was US$5.50/bushel.

On March 4th Syngenta had their first court hearing regarding litigation against them as the manufacturer of the herbicide *paraquat dichloride*, aka paraquat. More than 600 lawsuits allege that Syngenta knew that this highly toxic weed killer caused the nervous system disorder, Parkinson's Disease, and still went ahead with sales.

## Local and Regional Fuel Prices

★ Same

| All prices Bz$/Gal | Cayo, Belize | Quintana Roo, Mexico | Peten, Guatemala |
|---|---|---|---|
| REGULAR | ↑ $13.60 | ↑ $8.96 | ↑ $10.68 |
| PREMIUM | ↑ $13.56 ▲ | ↑ $8.97 | ↑ $10.91 |
| DIESEL | ↑ $13.51 | ↑ $8.04 | ↑ $10.46 |

▲ *Yes, premium was less than regular at print time; premium expected to increase soon.*

### *Letter to the Editor...Continued from page 4*

currently undergoing exemplifies our concern that their stated commitment "to be responsible stewards with respect to the safety and environmental impact of our operations and products" is ignored operationally. Public protest by Mexican citizens just south of Playa del Carmen where VMC is damaging the landscape by their mining operations should be proof of VMC's violation of their promises. Their stated commitment "to earn superior returns for our shareholders" seems to be of higher priority than adhering to conservation of nature in a land far removed from their shareholders. Just as the citizens in many local areas in the US have litigated against VMC to prevent them from damaging their environment we in Belize should be proactive to conserve our environment as well. We urge all citizens to express their concern to the government of Belize over this egregious attempt to exploit and destroy our natural resources and urge GOB to preserve Gale's Point for future generations to enjoy.

Board of Directors, Pro-Organic Belize

The EU recently approved certification of 3 types of insects as "fit for human consumption": house crickets, yellow mealworms, and grasshoppers. Perhaps they may seem tastier using their Latin names: *Pancrustacean hexapod* invertebrates. It is reported that 80% of the world's people eat insects as part of their normal diet. Nutritional values: crickets: 65% protein by weight (contains all essential amino acids); yellow mealworm larvae: 20% protein, 15% fat; grasshoppers: 46% protein, 37% fat, 17% carbs. Yellow mealworm larvae have been used in animal feeds (chicken, dog) for quite some time.

Bug-eating is promoted by some as being helpful to save the planet. If you need more information on how cattle, that is, grass fed cattle, are helpful to the planet, by sequestering carbon and adding organic matter to increase water retention in soil etc, please go to Dr. Christine Jones' article on pgs. 20-21 (this issue). The cattle operations doing harm are those feeding grain concentrates without roughages in feedlots for several months – which ruminants like cattle, being herbivores, are not even designed to digest well. Belize's grass-grazing cattle industry is helping sequester carbon and no Belizean rancher need apologize.

Meanwhile, elites such as Bill Gates, shareholder in several companies manufacturing lab grown "meats", advises in a MIT interview, that richer nations "should move to 100% synthetic beef" to fight climate change. He opined that "you will get used to the taste difference." Note: he said 'you' not 'I'.

**"Build your opponent a golden bridge to retreat across."**

**Sun Tzu:**



*From left to right, newly elected directors: Mr. Alexis Blanco, Mr. John Klassen, Mr. Ramon Galvez, Mr. Arden Edwards, Mr. James Dawson, Mr. Jefferey Reimer, Mr. Gerhard Klassen and Mr. Abram Froese.*

## BLPA holds AGM, 26th February 2022

The Belize Livestock Producers Association (BLPA), like many other associations and organizations, missed 2 years of AGMs due to circumstances. On February 26, 2022 BLPA held its 43rd Annual General Meeting (for their 45th year anniversary) at their grounds at Mile 47 ½ George Price Highway, with the largest attendance in its history - over 600 members present of the total 934 members registered between February 2018 to February 2022.

Missed AGMs meant missed Board of Director elections, so those serving / elected at the 2019 AGM continued to serve until the 2022 elections. Hence, the entire board of 8 positions was up for election. Those 4 nominees who received the most votes will serve for 2 years, and the next 4 receiving the most votes will serve for 1 year – reinstating the staggered pattern called for in bylaws, ensuring a permanent continuance of some directors – except under the most unusual conditions.

The top 4 vote-getters who will serve for 2 yrs. are: Mr. Arden Edwards of Yemeri Grove, Toledo District; Mr. James Dawson of Burrel Boom, Belize District; Mr. Jeffery Reimer of Spanish Lookout, Cayo District; and Mr. Abram Froese of Blue Creek, Orange Walk District. The newly elected directors who will serve for 1 year are: Mr. Alexis Blanco of Orange Walk District; Mr. Gerhard Penner of Shipyard, of Orange Walk; Mr. John Klassen of Blue Creek, Orange Walk District; and Mr. Ramon Galvez of Clarissa Falls, Cayo District. New officers of the board are: Mr. Jeffery Penner as chair; Mr. Ramon Galvez as vice-chair; Mr. Alexis Blanco as secretary; and Mr. James Dawson as treasurer.

As the guest speaker, Mr. Manuel Vasquez shared his thoughts on *The Prospects for Growth in Belize's Livestock Industry*

In other livestock news, Spanish Lookout's Expo outdid themselves with a spectacular livestock show early on the Expo's 2nd day, 26th March. World renowned livestock judge Mr. P. J. Budler, a South African native now resident in Texas, enlightened those present with his commentary as he declared winners.

**Show Cattle at the Expo from Paul Penner's XR Ranch**

## *Field Survey...Continued from page 8*

were identified, with the most poisoning incidents involving:

- 2,4-D or abamectin (15.5% each);
- glyphosate or paraquat (10.3% each),
- lambda cyhalothrin (8.2%).

The data also suggest that too many FFW combined many pesticides for farm work purposes, thereby risking contamination and poisoning by mixing multiple pesticides simultaneously.

The incidence of pesticide poisoning in Belize has been trending upwards; the most significant year over year increase is in the 2020 to 2021 period when the poisoning incidence among FFW almost doubled (i.e., 1.8 times) from 41 cases in 2020 to 73 cases in 2021. Kindly note that the increase in the incidence of pesticide poisoning in Belize for 2021 is even more significant as the period for 2020 was a full year while the period for 2021 was only January to August.

The majority of FFW respondents stated that they could read and understand the label on the pesticide. In comparison, 16.0% were not able to read and understand the label on the pesticide, and 10.0% were not sure or could not recall if they were capable of reading and understanding the label on the pesticide.

Because the reported major route of pesticide poisoning was by inhalation, there was a review of the personal protection equipment (PPE, i.e., rubber gloves, coverall / overall, goggles, respirator with cartridges, water boots, long sleeve shirt & long pants) being worn to protect from inhalation at the time of those incidents. Kindly note that 15 or 16.3% of the 92 FFW victims of inhalation poisoning were wearing "No PPE". In general, it seems that FFW victims of inhalation poisoning were wearing more ineffective PPE than effective PPE when working with pesticides on the farm. However, it is alarming that 15% of the cases occurred although recommended inhalation protection was being used. Even though the total complement of PPE works well, it is noteworthy at 2 of the 150 pesticide poisoning victims were wearing all the PPE; a future study would be good to determine how these two victims were still affected by the pesticides when they wore all PPE.

***Editor's note: The recommendations for addressing the problems identified in this study can be found in the FAO press release in the Online Annex Issue #45***

## *Ta'nah Farmers Group...Continued from page 30*

demand is greenhouse management training. Greenhouses are notable for increased yields on smaller land parcels, expanded time frame for harvesting, improved water management and reduced pesticide use - reduction of about 80%. Other training presentations sought out by the group include greenhouse management, water management and regenerative farming methods.

**Toledo District also has its own San Antonio.*

***Editor's note: The Belize Ag Report thanks Ta'nah President Mr. Obed Martinez and Vice-president Mr. Virgilio Coh for their time, sharing information about TFG. Thanks also go to Mr. James Mesh of Oxmul Coffee who generously assisted with translation.***

## *Sorghum, Milo...Continued from page 30*

**Merina's Tortillas de Maecillo Recipe:** 3 cups maecillo (sorghum or milo) flour

1 3/4 cups water to begin, gradually adding more until the correct "masa" consistency is achieved. For the thick hand formed tortillas, dip hands in water as needed to minimize cracking along edges. Total water may be close to 2 c.

Cook on a very hot comal. Yield: approx. 11 of 4.5" round thick tortillas. Yum!

These are a common type of tortilla in El Salvador. There, many cooks hand-grind the whole grains in a simple corn mill, then complete the milling to the desired fineness by stone grinding with a mano and metate. The test batch that Ms. Merina Martinez made for the Belize Ag Report used imported very fine sorghum flour, which she felt was too refined for her ideal tortillas.

***Find more sorghum/milo/maecillo recipes in the Online Annex Issue #45***

## *Belize Coconut National...Continued from page 17*

participatory approach which allows community role model farmers to encourage other fellow farmers, known as ring farmers, to participate in trainings and to test and adopt specific technologies. The objective of the lead farmer approach is to build capacity of local innovative farmers to effectively share knowledge and skills with other farmers within their localities.

In Belize twenty-three coconut farmers have been selected to start up the lead farm programme under the Coconut Regional Development Project. They will identify their ring farmers, at least 10 persons each, so in six months at least 230 farmers will be exposed and trained. If each one of those 230 ring farmers starts his/her own ring for training on his/her own farm, the group can expand to at least 2300 farmers by the end of 2022 and 23,000 farmers by the end of 2023 when the project comes to an end.

**Fig 2:** Exponential growth of the *Lead Farm model*: impact and replicability

The key benefits of the lead farm approach are not only the rapid expansion of training to more farmers, but as reported in other locations, the encouragement of long lasting exchange of information and adoption of technology, which fosters partnerships for trading, bulk purchasing and selling, and, more importantly, community friendships that can lead to development of successful community industries in which all players can benefit.

In Belize the lead farm approach in coconut seeks to provide training to cluster farmers through the participatory approach. The selected clusters are distributed in the six districts with 26% female and 74% male lead-farmers and of these 60% are youth and 40% older farmers.

From April 2022 to September 2022 the first 23 lead-farmers and their ring farmer's country will start a series of training sessions based on their needs and work programme involving:

- Technical knowledge transfer and desaturation of techniques and approaches in areas such as production, processing, marketing and business management;
- Support for farmer experimentation and trial and error practices for adapting techniques and options for improvement on the farm;
- Setting up demonstration plots for best agricultural practices in coconut production, crops diversification and integrated pest management (IPM),
- Market linkages and business management support including record keeping.

# Online Annex
# Table of Contents

Spring 2022
ISSUE 45

## References -

# A Carbon Friendly Beef Enterprise - Is It Possible?

**By Christine Jones, PhD**
**Founder, Amazing Carbon**

## References

1. Food and Agriculture Organisation of the United Nations (2006). Livestock's Long Shadow: Environmental Issues and Options. FAO, Rome http://www.fao.org/docrep/010/a0701e/a0701e00.htm

2. Nabhan, G., Blair, D. and Moroney, D. (2010). Ranching to produce Tacos Sin Carbon: the low carbon footprint of grass-fed beef and sheep production in the semi-arid west. The Quivira Coalition Journal, no. 35 February 2010.

3. Lundeen, T. (2010). UN staff admits flaw in report on meat and climate change. Stock & Land, 2nd April, 2010

4. Quirk T. W. (2010) Twentieth century sources of methane in the atmosphere. Energy and Environment, 21(3), pp. 251-256.

5. Dlugokencky, E. J. et al. (2009). Observational constraints on recent increases in the atmospheric CH4 burden. Geophysical Research Letters 36, L18803, doi:10.1029/2009GL039780.

6. Cawood, M. (2010). Error in Snowy soils carbon report. http://theland.farmonline.com.au/news/state/agribusiness-and-general/general/error-in-snowy-soilscarbon-report/1887462.aspx

7. Dunfield, P. F. (2007). The soil methane sink. In D.S. Reay, C.N. Hewitt, K.A Smith and J. Grace, eds. Greenhouse Gas Sinks. pp. 152-170. Wallingford UK.

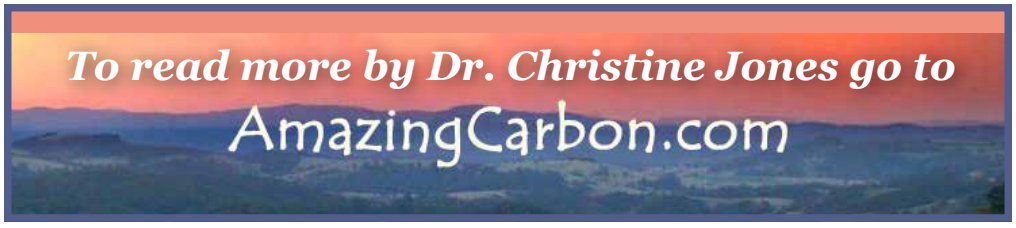
8. Pimental, D. and Pimental, M. H. (2008). Food, Energy and Society. Third Edition. CRC Press, Boca Raton, Fl, USA: CRC Press/Taylor and Francis Group. ISBN 978-1-4200-4667-0.

9. Abend, L (2010). How Cows (Grass-Fed Only) Could Save the Planet. 25 January 2010 http://www.time.com/time/magazine/article/0,9171,1953692,00.html

10. Simopoulos, A., P. and Robinson, J (1999). The Omega Diet. Harper Collins.

11. McLagan, J. (2008). Fat: an appreciation of a misunderstood ingredient, with recipes. Ten Speed Press, California.

12. Mercola (2010). The ominous beef cover up - the hidden truth behind the meat on your plate. http://articles.mercola.com/sites/articles/archive/2010/03/23/how-grassfed-cows-could-save-theplanet. aspx 23 March 2010.



## Ingredients

3/4 cup butter, softened
1 1/2 cups raw brown sugar
4 large eggs
1 1/2 cups sorghum flour
1 cup fine yellow cornmeal
2 teaspoons baking powder
1 teaspoon salt
3/4 cup sour cream
1 Tablespoon orange zest plus 1/2 cup fresh juice (about 2 oranges)
2 teaspoons vanilla
1 1/2 cups fresh peaches, sliced
1 1/2 cups fresh blueberries
2 black or red plums, sliced
2 Tablespoons raw brown sugar

# *Sorghum Cornmeal Breakfast Cake*

## Instructions

1. Preheat oven to 350 degrees F. Spray 13”x9” baking pan with cooking spray. Beat butter and sugar at medium speed until light and fluffy.
2. Add eggs one at a time, beating after each.
3. Whisk together dry ingredients in a medium bowl.
4. Whisk together sour cream, zest, juice and vanilla in a separate bowl.
5. Add flour mix to butter mix alternating with the sour cream mixture, beginning and ending with flour mix.
6. Beat at low speed just until blended after each addition.
7. Spread batter into baking pan and scatter berries and fruit on top.
8. Sprinkle with demerara sugar.
9. Bake until a wooden pick inserted in center of cake comes out clean—55 to 65 minutes.
10. Cool on wire rack for 20 minutes.
11. Cut into squares and serve warm or at room temp. May top with sorghum-sweetened whipped cream!

Prep time 10 minutes. Cook time 55 minutes.

Compliments of Barbara Kliment, Executive Director-Nebraska Grain Sorghum Board

## Ingredients

1 cup sorghum flour
2/3 cup tapioca flour
2/3 cup cornstarch
1 1/2 teaspoons xanthan gum
1/3 cup dry milk powder or nondairy substitute
1/2 teaspoon salt 1 teaspoon unflavored gelatin
1 teaspoon baking powder
3 tablespoons sugar
2 1/4 teaspoons dry yeast granules
2 eggs
1/2 teaspoon vinegar
3 tablespoons vegetable oil
1 cup lukewarm water
Greased pan 8½" by 4½"

# *Kenya Sorghum Bread*

## Instructions

1. Grease loaf pan and dust with rice flour.
2. Mix the dry ingredients in a medium bowl.
3. Beat eggs, vinegar and oil in the mixing bowl of a heavy duty mixer or whisk the eggs, vinegar and oil.
4. Add most of the water, holding back about 3 tablespoons to add as needed.
5. Turn mixer to low and add the flour mixture a little at a time. The mixture should be the consistency of cake batter.
6. Add the remaining water a little at a time to achieve this texture.
7. Turn mixer to high and beat for 3½ minutes.
8. Spoon into the prepared pan, cover and let rise in a warm place about 35 minutes for rapid rising yeast; 60 or so minutes for regular yeast or until dough reaches the top of the pan.
9. Bake for 50 to 55 minutes in a 400°F oven. Cover after 10 minutes with aluminum foil.
10. For a softer crust, rub immediately with butter or oil.
11. Cool before slicing.

Compliments of Kenya Agricultural Research Institute

## Ingredients

1 2/3 cup sorghum flour
2/3 cup rice flour
2/3 cup corn flour or cornstarch
2 ¾ teaspoons of dry yeast granules
1 teaspoon baking powder
1/2 teaspoon salt
1 teaspoon unflavored gelatin
3 tablespoons raw sugar
1/2 teaspoon apple cider vinegar
3 tablespoons coconut oil
1 cup lukewarm water plus
Seeds for crust (optional)
Greased pan 8½" by 4½"

# *Tri Grain Sorghum Loaf Bread*

## Instructions

1. Grease loaf pan and dust with rice flour or line with paper.
2. Mix the dry ingredients in a medium bowl.
3. Mix apple cider vinegar and coconut oil in the mixing bowl of a heavy duty mixer or whisk the vinegar and oil.
4. Add most of the water, holding back about 3 tablespoons to add as needed.
5. Turn mixer to low and add the flour mixture a little at a time. The mixture should be the consistency of cake batter.
6. Add the remaining water a little at a time to achieve this texture.
7. Turn mixer to high and beat for 3½ minutes.
8. Spoon into the prepared pan, sprinkle seeds on top (optional), cover and let rise in a warm place about 35 minutes for rapid rising yeast; 60 or so minutes for regular yeast or until dough reaches the top of the pan.
9. Bake for 50 to 55 minutes in a 400°F oven. Cover after 10 minutes with aluminum foil.
10. Remove from oven, remove foil and cool on rack.
11. For a softer crust, brush immediately with coconut oil.
12. Cool before slicing.

# *Ethiopian Fermented Sourdough Flat Bread - Injera*

## Instructions

1. In a large bowl combine all the ingredients, then start by adding a cup of water at a time to prevent lumps to make a smooth batter. .
2. Continue adding water, one cup at a time water until the water is completely used up. Due the variation in humidity in the air, it is difficult to state the exact amount of water. Injera should be thicker than a crêpe, but not as thick as a traditional American pancake.
3. Loosely cover with kitchen towel, let it rise for about 2 hours until bubbles form.
4. Heat up a skillet, crepe pan, or non-stick fry pan preferably one with a matching lid.
5. Heat the skillet on medium high heat, and then when ready to cook pour a ladleful (about ¾ cup or more) of the injera batter on the pan; spread from the center in a circular motion about the size of a dinner plate. You may cover if you have a matching lid as covering shortens the cook time. Otherwise let it cook until all batter forms little brown spots coming through. No need to turn the batter.
6. Transfer to a plate with a spatula or plate, put aside and continue cooking until the batter is finished

Prep time 10 minutes. Cook time 55 minutes.

## Ingredients

1 cup corn flour
1/2 cup sorghum flour
1 Tablespoon sugar
1 Tablespoon dry yeast
1 1/4 cup warm water
4 cups all purpose flour
6 teaspoons baking powder
4 teaspoons salt
¼ cup sugar
4 cups warm water

## *Sorghum Banana Bread*

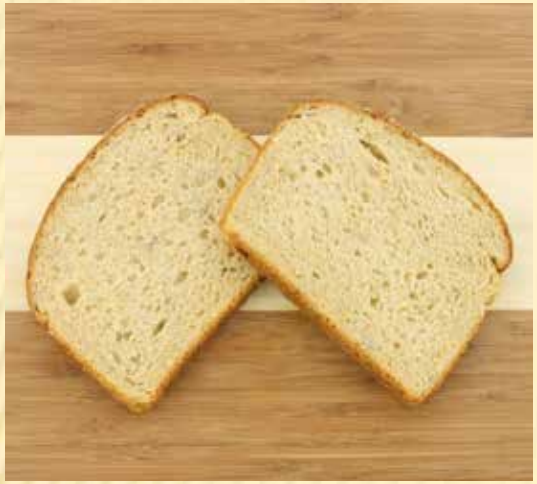
### Ingredients

2 cups  sorgham flour
1 teaspoon baking soda
1 teaspoon baking powder
1/2 teaspoon salt
1 teaspoon cinnamon
8 tablespoon unsalted butter
3/4 cup brown sugar
2 eggs beaten
2 1/3 cups mashed overripe bananas (approximately 4 bananas)
1 teaspoon vanilla extract
1/2 cup buttermilk

### Instructions

1. Preheat oven at 325 degrees F.
2. In a bowl, whisk together Wondergrain flour, baking soda, baking powder, salt and cinnamon. Set aside. In a large bowl, cream the butter and sugar with a hand mixer. Add beaten eggs and mashed bananas. Mix well with the spatula. Add vanilla extract and buttermilk and beat with mixer until combined. Very gently fold in the dry mixture into the wet mixture with the spatula. DO NOT OVER STIR but mix well.
3. Pour the batter into a 9x5 greased loaf pan. Bake on center rack for 1 hour and 10 minutes, but check on the bread after 1 hour. Cooking time may vary.
4. Insert a toothpick at the center and it should come out clean. Bread should be golden on the outside. Let cool for 10 minutes and then remove the bread from the pan and place on a cooling rack to finish cooling. Allow the bread to cool down completely prior to cutting.

Prep time 15 minutes. Cook time 70 minutes.



## Ingredients

2 teaspoons active dry yeast
1 teaspoons xanthan gum
1 teaspoons sugar
2 teaspoons baking soda
½ cup warm water
1 teaspoon salt
1 ½ cups sorghum flour
1 tablespoon apple cider vinegar
1 cup brown rice flour
2 eggs
½ cup tapioca (yucca, corn) flour
2 tablespoons olive (coconut) oil
½ cup club soda
2 tablespoons flaxseed meal (optional)

# *Campfire Sorghum Bread*

## Instructions

1. Prepare your camp Dutch oven by oiling well with olive oil.
2. Combine yeast, sugar and warm water to activate yeast. Let sit for 15 minutes.
3. Mix the dry ingredients. Then add yeast mixture to dry ingredients. Add apple cider vinegar, then the eggs, one at a time, then the oil. Mix well between additions.
4. Pour in the club soda in a slow drizzle, adding just enough to wet all the ingredients completely. The dough should feel soft and firm.
5. Turn out onto a surface floured with rice flour and knead well. Gluten free dough is much looser than wheat flour dough. Place dough back in mixing bowl and cover with a towel. Allow to rise in a warm place for about 1 hour.
6. Meanwhile, after dough has risen about 30 minutes, start your fire using BBQ briquettes. Allow your camp oven to sit, covered, on the briquettes to heat up.
7. When dough has risen, place it in your well-oiled, hot camp oven. Set your camp oven back among the briquettes. Place 10-12 briquettes on the lid of thr  oven.
8. Allow to bake approximately 30-40 minutes (baking time varies depending on fire temperature). Check on bread at any time while baking.
9. Remove bread, slice, slather with butter. Enjoy!

*The gluten -free bread is so delicious, healthy as a whole meal with fibre, affordable and attractive.*

*Note: Gluten-free breads need to be frozen if not eaten within a day to avoid microbial growth. Slice bread, package and store in a cool place.*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**Kshs. 30**


# HOW TO MAKE SORGHUM BREAD (Gluten free)

Discover the wonders of sorghum and stay healthy

## Introduction

Sorghum is an important food crop in many parts of Kenya, providing livelihoods to more than 3 million people. It is rich in calories, has vitamin B and essential amino-acids.

Value addition in Sorghum in human nutrition has been found to be very innovative.

### Ingredients

1. 1 cup sorghum flour
2. 2/3 cup tapioca flour
3. 2/3 cup cornstarch
4. 1 1/2 teaspoons xanthan gum
5. 1/3 cup dry milk powder or nondairy substitute
6. 1/2 teaspoon salt 1 teaspoon unflavored gelatin
7. 1 teaspoon baking powder
8. 3 tablespoons sugar
9. 2 1/4 teaspoons dry yeast granules
10. 1/2 teaspoon dough enhancer or vinegar
11. 3 tablespoons vegetable oil
12. 1 cup lukewarm water

2 eggs

Greased pan 8½" by 4½"

### Method

- Grease loaf pan and dust with rice flour.
- Mix the dry ingredients in a medium bowl.

- Beat all ingredients in the mixing bowl of a heavy duty mixer, whisk the eggs, dough enhancer and oil.
- Add most of the water, holding back about 3 tablespoons to add as needed.
- Turn mixer to low and add the flour mixture a little at a time. The mixture should be the consistency of cake batter.
- Add the remaining water a little at a time to achieve this texture.
- Turn mixer to high and beat for 3½ minutes.
- Spoon into the prepared pan, cover and let rise in a warm place about 35 minutes for rapid rising yeast; 60 or so minutes for regular yeast or until dough reaches the top of the pan.
- Bake for 50 to 55 minutes in a 400°F oven. Cover after 10 minutes with aluminum foil.
- Turn off the oven to let it cool. For a softer crust, rub immediately with butter or oil. Cool before slicing.

Food and Agriculture Organization of the United Nations

NEWS RELEASE

www.fao.org

# Pesticide poisoning in Belize: Addressing the upward trend

***FAO study reveals upward trend in incidences of accidental pesticide poisoning among farmers and farm workers in Belize***

**March 1, 2022.** The issue of pesticide poisoning among farmers and farm workers appears to be a growing area of concern in Belize that authorities are now seeking to address.

A recent study conducted by the Food and Agriculture Organization of the United Nations (FAO), in collaboration with the University of Belize, revealed that there seemed to be a substantial increase in the cases of accidental pesticide poisoning in the year 2021, compared to the previous two years. These findings were presented during a workshop on Pesticide Poisoning among Farmers and Farm Workers in Belize held virtually on February 24, 2022.

The survey recorded incidences of accidental pesticide poisoning, over a three-year period, among 150 farmers and farm workers from the Cayo District, Toledo, Orange Walk, Stann Creek, Corazal and Belize District. Those from the Belize District reported their incidences of pesticide poisoning occurring outside of the district.

Over 80 stakeholders from the Pesticides Control Board, the Ministry of Agriculture, the Ministry of Health and Wellness, the University of Belize, CARDI, pesticides importers and distributors and farmers met during the virtual workshop where they examined and discussed the report of the survey.

FAO Representative for Belize, Dr Crispim Moreira noted that the survey is one of the "efforts to address pesticide management in a holistic manner and to ensure that we are protecting human health whilst working towards a future that is food secure."

**Examining the incidences of pesticides poisoning**

The report, presented by Dr Sherlene Enriquez-Savery of the University of Belize and FAO Project Coordinator Mr Michael Ramsay, highlighted several health problems with varying levels of severity as reported by the farmers and farm workers. In some cases, this was a result of the toxicity and improper mixing and application of pesticides, which led in many cases to skin irritations, itching, burns and headaches, while some victims experienced much more severe symptoms. Exposure to chemicals was mainly the result of inadequate use, negligence or availability of Personal Protective Equipment (PPE). Most persons affected by pesticides sought to self-medicate (even when the symptoms were severe) while very few others visited hospitals and clinics for professional medical attention.

Whilst exposure to pesticides can pose a serious health risk, the study revealed that this could be avoided by improving farmer education on the health impacts of pesticides, the proper use of these chemicals and the importance of PPEs. The participants agreed that there was an urgent need to influence behavior changes in farmers who opted out of wearing PPEs.

Mr Mario Yarto from the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade spoke about the Convention as a vital multilateral agreement for information sharing on chemicals. Belize has been a Party to the convention since 2005. On this basis, he remarked that the meeting was an opportunity to support the Government of Belize in strengthening its decision-making capacity towards better pesticides management and improved protection of public health.

**Looking ahead**

Several recommendations were put forward to aid in reducing the incidences of pesticide poisoning, including a review of the pesticides and their active ingredients identified by the survey as being a health problem, and addressing the knowledge, attitudes, and pesticide practices of farmers, farm workers and their employers.

Miriam Ochaeta-Serrut, Registrar for the Pesticides Control Board, highlighted that "these recommendations, supported by the data from the study, were essential in influencing policies in the country on pesticide management". She added that the "restricting of certain pesticides and training on their use required additional regulatory action, more research to inform policy, increased industry stewardship, improved user responsibility, and overall behavioural change among pesticide users in Belize".

She concluded that, "plans were already in place to move Belize towards more agro-ecological solutions for pest management. With increased inter-agency collaboration with the Ministry of Health and the data provided by the survey, the country could push for more evidence-based policies and legislation that chart a new era in pesticide management in Belize". Submission of notifications of final regulatory action to the Rotterdam Convention may be expected in the coming months resulting from the survey

**For more information, please contact:**

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University of Belize

Education Empowers a Nation

# Field Survey: Collection and Analysis of Data on Pesticide Poisoning Incidents among Farmers in Belize 2021

## Stakeholder's Presentation

By

Dr. Sherlene Enriquez-Savery

Mr. Sean Sebastian

# PRESENTATION OUTLINE

- INTRODUCTION
- OBJECTIVE
- QUESTIONNAIRE STRUCTURE
- THE SURVEY TEAM
- KEY FINDINGS
- CONCLUSION
- RECOMMENDATIONS

# INTRODUCTION

- In June 2020, the University of Belize (UB) administered a field survey titled; Collection and Analysis of Data on Pesticide Poisoning Incidents among Farmers in Belize. The field Survey was a partnership between UB and the Food and Agriculture Organization of the United Nations (FAO).

- The Rotterdam Convention of the United Nations, to which Belize is a Party, has a core objective of mitigating the adverse effects of pesticides on human health. This includes actions to reduce poisoning incidents due to Severely Hazardous Pesticides Formulations.

- The survey was administered to a total of 150 Farmers and Farm Workers (FFW), representing an effective response rate of 100.0%.

# OBJECTIVE

- The objective of the survey is to identify pesticides that appear to be significant health hazards under the normal conditions of use

# QUESTIONNAIRE STRUCTURE

The Belize Pesticide Poisoning among Farmers & Farm Workers Survey questionnaire included 42 questions, covering questions such as:

- Gender and age of the respondent
- Name of the pesticide involved
- How the incident occurred
- What Personal Protective Equipment (PPE) was being used at the time of the incident (if any)
- If not, why were the required PPE not being worn
- Route of exposure (nose, skin, eyes, mouth)
- Acute health problems experienced as a result
- What treatment was given, including self-treatment or medical attention was sought.
- Data collector's information.

# THE SURVEY TEAM

Statisticians

- Dr. Sherlene Enriquez Savery
- Mr. Sean Sebastian

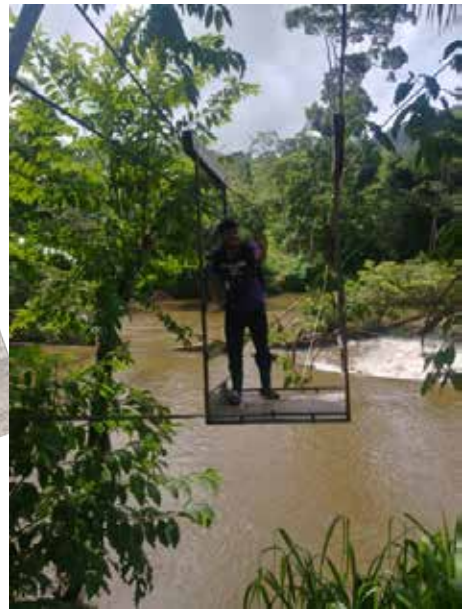
Field supervisor & Technical Expert

- Mrs. Zoe Zetina
- Mr. Francisco Tzul

Data Collectors-Senior Agriculture Majors

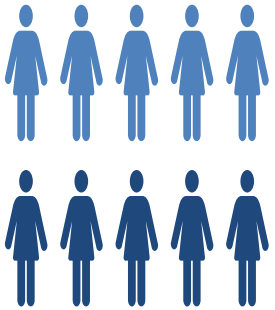
Sharyah Palacio, Melvin Requena, Amsi Morales, Dyrin Leon, Gabriel Campos, Shantel Sutherland, Marleny Dominguez, Dale Pech

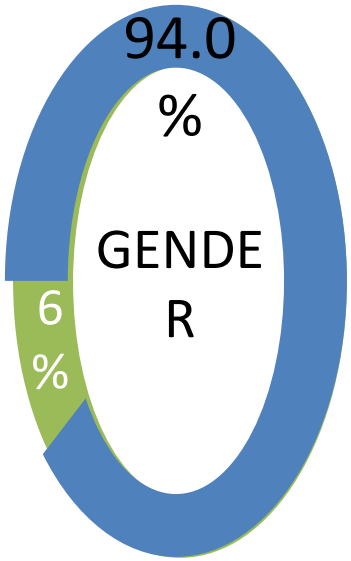
# THE SURVEY TEAM



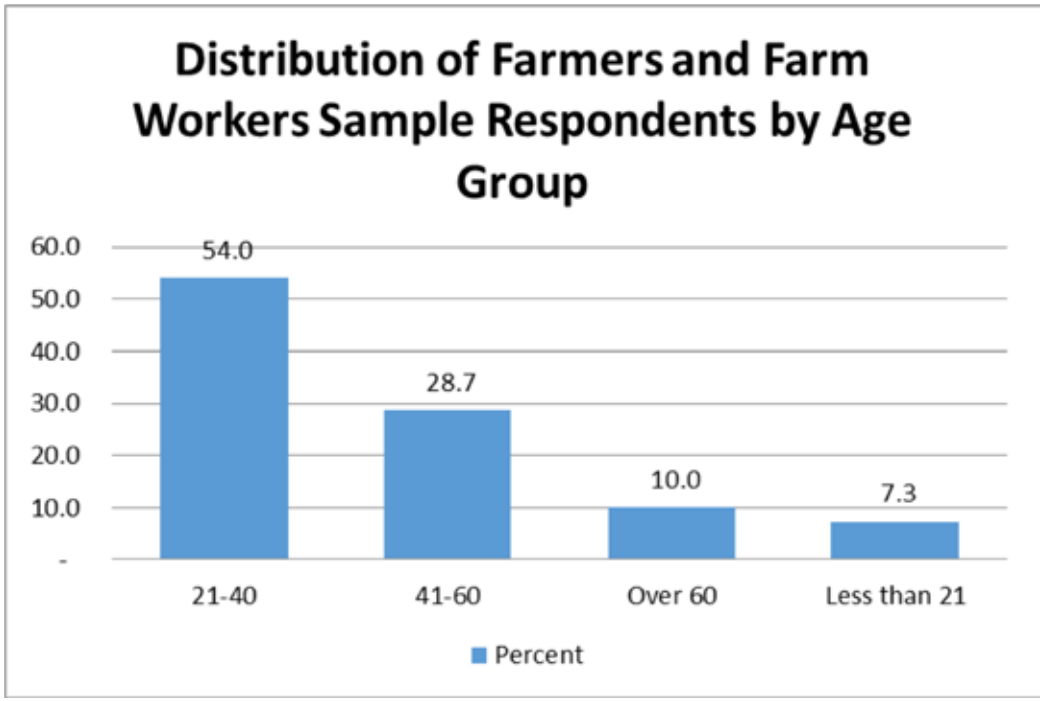
# KEY FINDINGS

Male

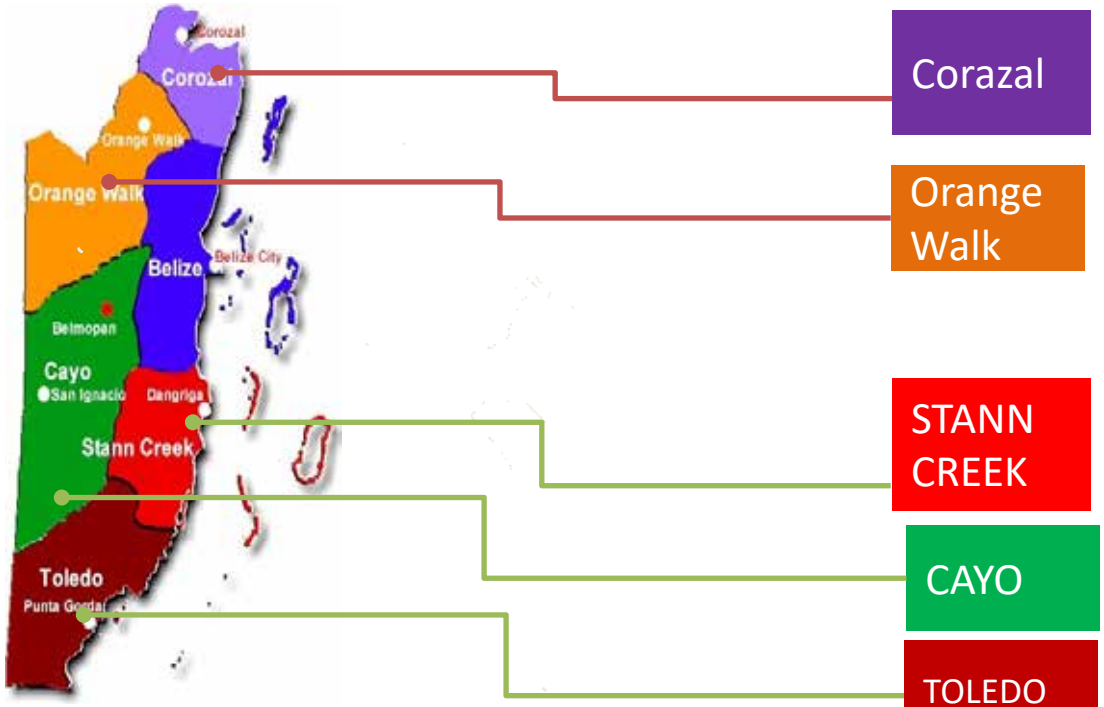


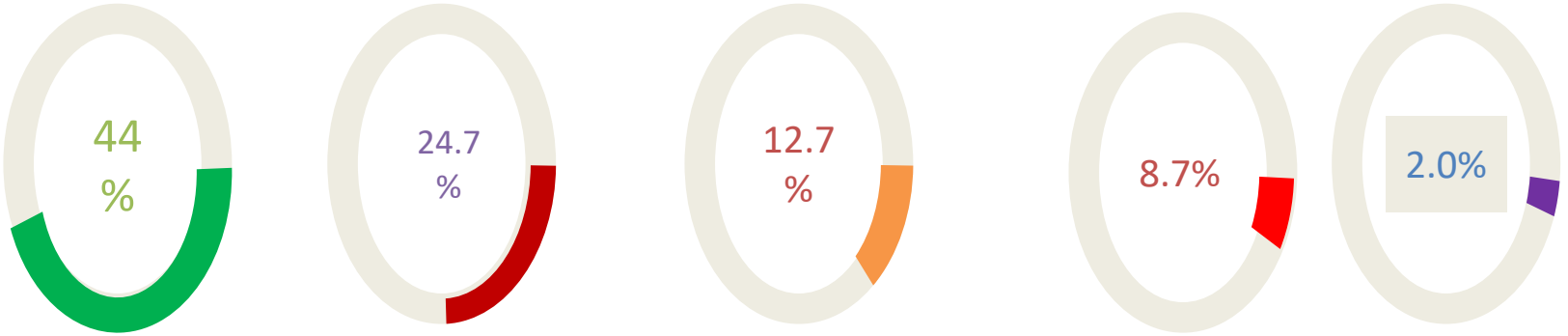



Female

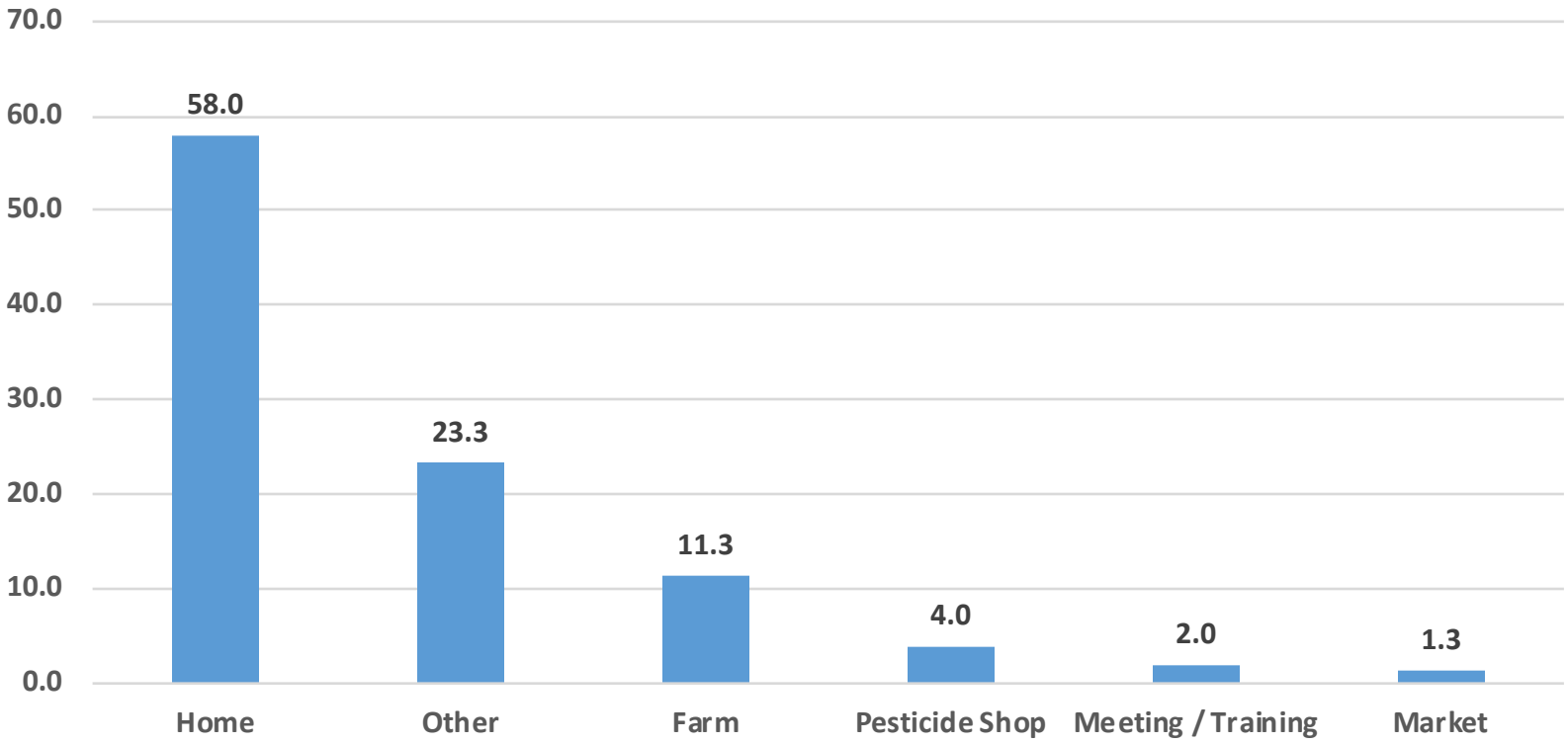


# District Where the Poisoning Incident Occurred



# Distribution of FFW Place of Interview



# Where on your body did the pesticide get on you, or into you?

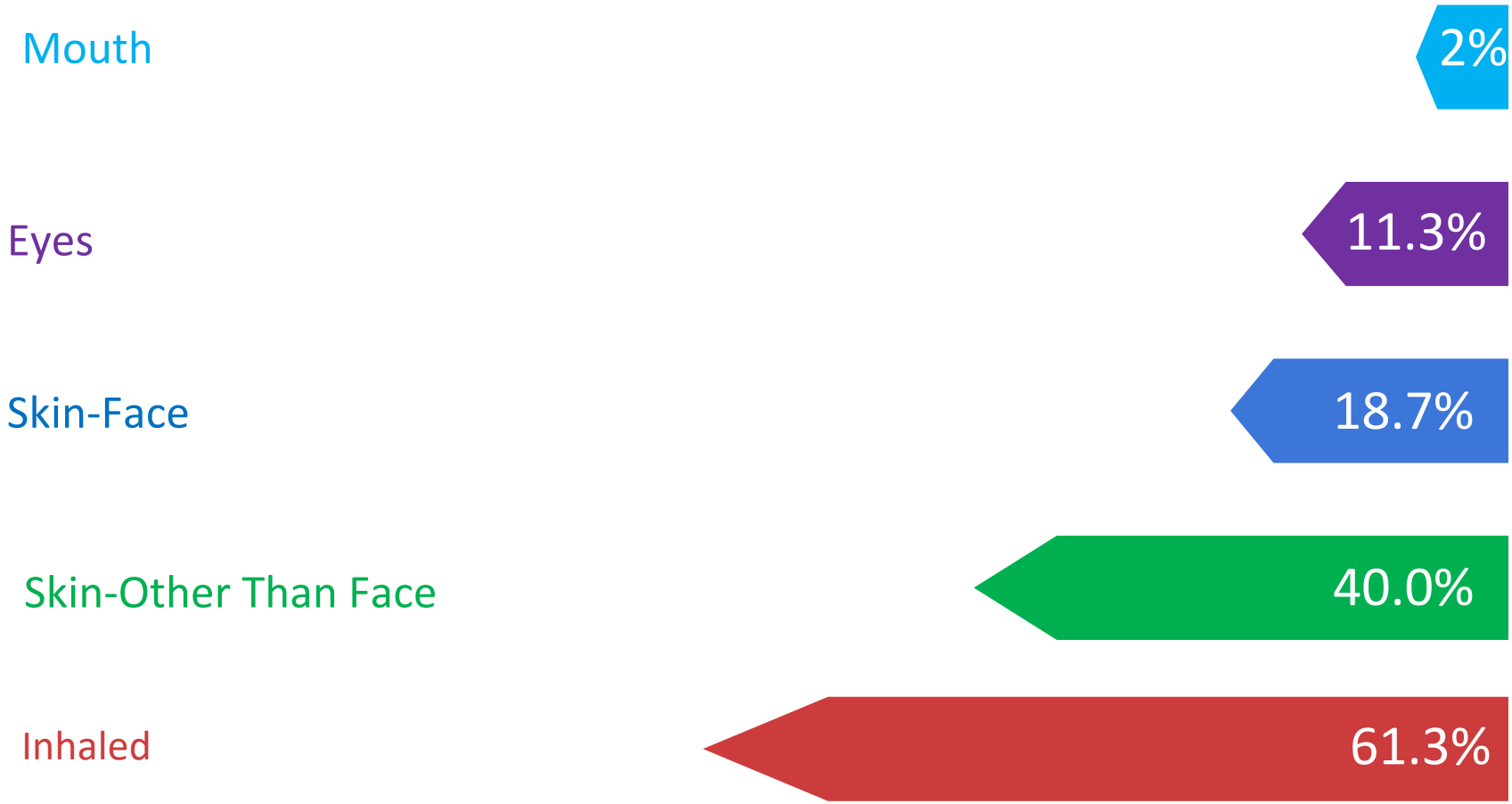


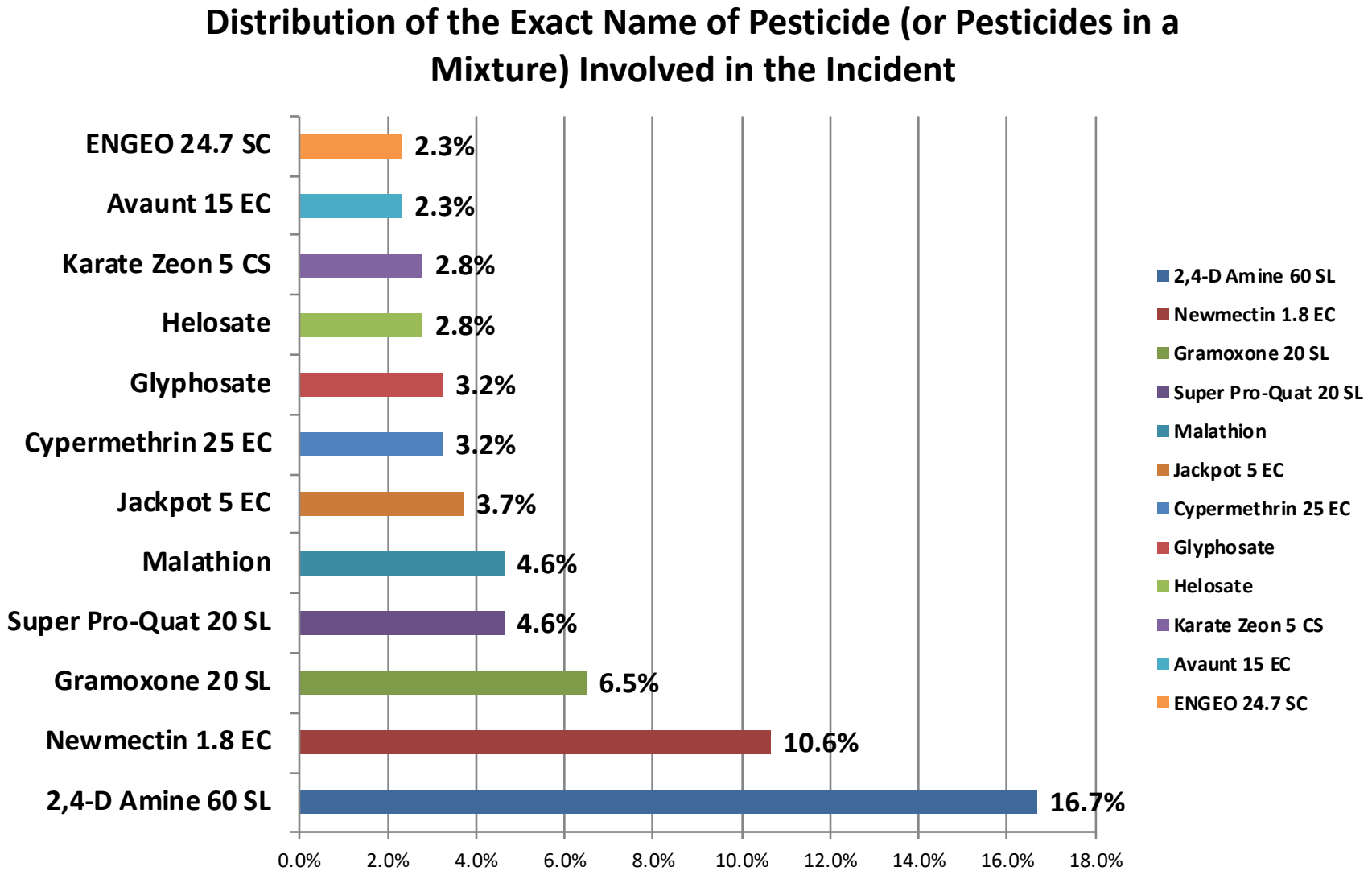
**Table 3: Distribution of Farmers and Farm Workers Sample Respondents by Where on your body did the pesticide get on you, or into you?**

| Where on your body did the pesticide get on you, or into you? | Frequency | Percent |
|---|---|---|
| Inhaled | 92 | 61.3 |
| Skin-Other Than Face | 60 | 40.0 |
| Skin-Face | 28 | 18.7 |
| Eyes | 17 | 11.3 |
| Mouth | 3 | 2.0 |
| **Total** | **150** | **100.0** |

Note: Sum of each frequency and percent value does not equal to respective Totals shown (i.e. 150 instead of 186 and 100% instead of 124%) since a respondent can select more than one option of the position on their body where the pesticide got on them, or into them.

**Distribution of Farmers and Farm Workers Sample Respondents by Pesticides and Do you think this pesticide being used on the farm is a health problem?**

| Pesticides | Do you think this pesticide being used on the farm is a health problem? | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Yes | | No | | Not Sure | | Total | |
| | Frequency | Percent | Frequency | Percent | Frequency | Percent | Frequency | Percent |
| Gramoxone 20 SL | 117 | 78.0% | 12 | 8.0% | 21 | 14.0% | 150 | 100.0% |
| 2,4-D Amine 60 SL | 114 | 76.0% | 12 | 8.0% | 24 | 16.0% | 150 | 100.0% |
| Lannate 21 | 84 | 56.0% | 13 | 8.7% | 53 | 35.3% | 150 | 100.0% |
| Super Pro_Quat 20 SL | 83 | 55.3% | 11 | 7.3% | 56 | 37.3% | 150 | 100.0% |
| Mortel 20 SC | 78 | 52.0% | 23 | 15.3% | 49 | 32.7% | 150 | 100.0% |
| Newmectin 1 | 78 | 52.0% | 23 | 15.3% | 49 | 32.7% | 150 | 100.0% |
| Sulban 48 EC | 66 | 44.0% | 11 | 7.3% | 73 | 48.7% | 150 | 100.0% |
| Jackpot 5 EC | 65 | 43.3% | 11 | 7.3% | 74 | 49.3% | 150 | 100.0% |
| Sulban 5 DP | 65 | 43.3% | 10 | 6.7% | 75 | 50.0% | 150 | 100.0% |
| …. | …. | …. | …. | …. | …. | …. | …. | …. |
| Totem 72 SL | 32 | 21.3% | 5 | 3.3% | 113 | 75.3% | 150 | 100.0% |
| Cypersul 25 EC | 31 | 20.7% | 5 | 3.3% | 114 | 76.0% | 150 | 100.0% |
| Capture 60 SL | 30 | 20.0% | 4 | 2.7% | 116 | 77.3% | 150 | 100.0% |
| DMA 68 | 27 | 18.0% | 7 | 4.7% | 116 | 77.3% | 150 | 100.0% |
| Forater 15 GR | 27 | 18.0% | 4 | 2.7% | 119 | 79.3% | 150 | 100.0% |
| Etocop 15 GR | 26 | 17.3% | 3 | 2.0% | 121 | 80.7% | 150 | 100.0% |


Distribution of the Exact Name of Pesticide (or Pesticides in a Mixture) Involved in the Incident
ENGEO 24.7 SC
Avaunt 15 EC
Karate Zeon 5 CS
Helosate
Glyphosate
Cypermethrin 25 EC
Jackpot 5 EC
Malathion
Super Pro-Quat 20 SL
Gramoxone 20 SL
Newmectin 1.8 EC
2,4-D Amine 60 SL
2.3%
2.3%
2.8%
2.8%
3.2%
3.2%
3.7%
4.6%
4.6%
6.5%
10.6%
16.7%
0.0%
2.0%
4.0%
6.0%
8.0%
10.0%
12.0%
14.0%
16.0%
18.0%
2,4-D Amine 60 SL
Newmectin 1.8 EC
Gramoxone 20 SL
Super Pro-Quat 20 SL
Malathion
Jackpot 5 EC
Cypermethrin 25 EC
Glyphosate
Helosate
Karate Zeon 5 CS
Avaunt 15 EC
ENGEO 24.7 SC

# Class I Toxicity

- Noteworthy, none of these pesticides that made this top 10 list were from the Class I Toxicity (most toxic pesticides) group.

- The pesticides from the Class I Toxicity group involved in the incident were:
  - **Vydate 24 SL, 17th**
  - **Lannate 21.6 SL, 19th**
  - **Lannate 90 SP , 20th**
  - **Lash 90 SP, 26th,**

- A subsequent review of the pesticides was done to identify the reported pesticides' active ingredients . Some 27 active ingredients were identified, with the most poisoning incidents involving
  - **2,4-D or abamectin (15.5% each);**
  - **glyphosate or paraquat (10.3% each),**
  - **lambda cyhalothrin (8.2%).**

# Pesticide Mixture Status

| Table 5: Distribution of Farmers and Farm Workers Sample Respondents by Pesticides Mixture Status | | |
|---|---|---|
| **Pesticides Mixture Status** | **Frequency** | **Percent** |
| 1 | 100 | 66.7 |
| 2 | 35 | 23.3 |
| 3 | 11 | 7.3 |
| 5 | 3 | 2.0 |
| 7 | 1 | 0.7 |
| **Total** | **150** | **100.0** |

# What were the health problems you experienced and how severe (how bad) was each health problem?

## Extremely severe or very serious health problems

For those FFW respondents who had extremely severe or very serious health problems after experiencing pesticide poisoning, the top three (3) health problems experienced were

- Headache (15.3%),
- Skin Irritation, or Itching (14.0%), and
- Skin Burns (13.3%).

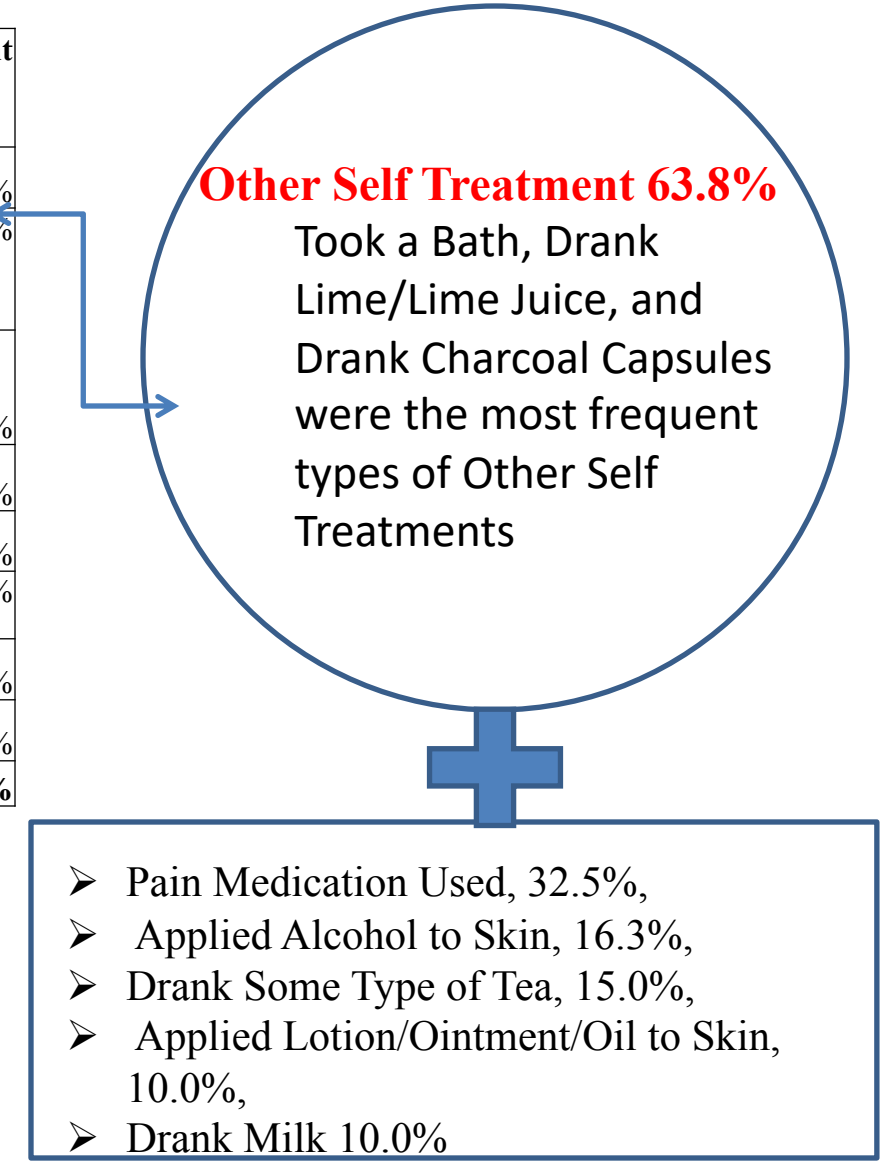
## Somewhat severe or somewhat of a problem

For those FFW respondents who had somewhat severe or somewhat of a problem after experiencing pesticide poisoning, the top three (3) health problems experienced were

- Headache (28.0%),
- Skin Irritation, or Itching (19.3%), and
- Sneezing (16.0%).

**Table 7: Distribution of Farmers and Farm Workers Sample Respondents by What did you do when you felt the effects of the pesticide?**

| Actions Taken When Respondent Felt the Effects of the Pesticide | Frequency | Percent |
|---|---|---|
| Self-Treatment | 80 | 53.3% |
| I Continued Spraying, and After I had Finished, I Washed the Chemical Off | 61 | 40.7% |
| Washed the Chemical Off Immediately | 35 | 23.3% |
| Rested/ Stopped Using the Pesticide | 29 | 19.3% |
| Nothing / No Action | 12 | 8.0% |
| Went to Hospital | 4 | 2.7% |
| Went to Health Centre | 2 | 1.3% |
| Went to Private Doctor | 1 | 0.7% |
| **Total** | **150** | **100.0%** |



# Treated by a private doctor or at a health centre or hospital

- Seven (7) Farmers and Farm Workers respondents were treated by a private doctor or at a health Centre or hospital after experiencing Pesticide Poisoning

- Out of the seven (7) FFW who visited a private doctor, or was treated at a health Centre or hospital after experiencing Pesticide Poisoning by the droplets and smell of the pesticide,

  - four (4) made two (2) hospital visits,
  - two (2) made one (1) hospital visit, and
  - one (1) made five (5) hospital visits.

# The Doctor's Diagnosis

A. being intoxicated by the usage of chemicals,
B. excessive stomach pain,
C. chemical affected eyes,
D. throat infection due to pesticides,
E. slight damages in respiratory system and dizziness,
F. the chemical used caused the skin rash, irritation, and burning and
G. poisoned by the droplets and smell of the pesticide which fell on to the skin and the toxic aroma of the pesticide which was applied without the proper protective gear.

- Two (2) salient points that were observed is that FFW respondents are working on the farm without the proper protective gear and that a respondent got affected by the pesticide when washing the clothing of respondent or when the farmer is in close contact with people after using pesticide at the farm. **These incidents can be reduced by sharing best practice measures with the Farmers and Farm Workers.**

# The pesticides or pesticide mixture used by FFW that resulted in poisoning incidents that required medical attention

1) Atom 2.5 EC, Bondacep (Yellow Powder)
2) 2,4-D Amine 60 SL,
3) Gramoxone 20 SL, Jackpot 5 EC,
4) Malathion,
5) Gramoxone 20 SL,
6) Elimina 60 SL, Elimina 72 SL,
7) 2,4-D Amine 60 SL, Amistar

The top three (3) pesticides or pesticide mixtures that caused the FFW to miss the most days from work were **Atom 2.5 EC**, **Bondacep (Yellow Powder)** with seven (7) Days of incapacity, **Gramoxone 20 SL & Jackpot 5 EC** with six (6) sickness days and **Gramoxone 20 SL** with also six (6) sickness days. The FFW who was away from work for seven (7) days experienced a Pesticide Poisoning Symptom of Excessive Stomach pain. However, one (1) of the other two (2) FFW, who each had six (6) days of incapacity, experienced Throat Infection while the other FFW got a Skin Rash along with Irritation and Burning.

Table 9: Distribution of Farmers and Farm Workers Sample Respondents who were treated by a private doctor or at a health Centre or hospital by Selected Characteristics

| Sex | Age Group | Pesticide/ Pesticide Mixture | Poisoning Symptoms | Health Facility | Number of Visits | Doctor's Diagnosis, Medication & Treatment Received, Other Relevant Details (self-reported) | Days in Hospital | Days Unable to Work |
|---|---|---|---|---|---|---|---|---|
| Male | Over 60 | Atom 2.5 EC, Bondacep (Yellow Powder) | Excessive Stomach pain | San Ignacio Hospital | 2 | Injection | 1 | 7 |
| Male | 41-60 | 2,4-D Amine 60 SL | Doctor stated that he was being intoxicated by the usage of chemicals. | San Antonio Health Centre | 2 | The doctor gave the farmer some tylenol for the headache and gave him a cream (Andi-cort 1%) for the skin burns and irritation. | 1 | 0 |
| Male | 21-40 | Gramoxone 20 SL, Jackpot 5 EC | Throat infection due to pesticides | Punta Gorda Health Center | 1 | Antiobiotics, pills for inflammation of lungs and infection of throat | 1 | 6 |
| Male | Less than 21 | Malathion | Doctor diagnosis was that the Farmer was poisoned by the droplets and smell of the pesticide which fell on to his skin and the toxic aroma of the pesticide which he was applying with out the proper protective gear | Punta Gorda community Hospital | 1 | Doctor treatment: antibiotics for the skin rashes, one injection shot to reduces swelling of the skin and to prevent further allergic reaction from the pesticide, Medication pill to clean out the lungs and to prevent swelling which can be caused by the toxic air that may have enter the lungs during application and was recommendation to drink a lot of water to clean out his system. Along with proper rest and avoid using the pesticide. | 1 | 2 |
| Male | 41-60 | Gramoxone 20 SL | The doctor told him that the chemical he used is what caused the skin rash and irritation and burning. And if he kept using it the burning could have been worse. | Northern Regional Hospital | 2 | The doctor gave him an ointment for the itching and irritation to use. The doctor said to use the ointment every day until his skin cleared up | 1 | 6 |
| Female | Over 60 | Elimina 60 SL, Elimina 72 SL | The doctor found slight damages in her respiratory system and dizziness and stated that | Northern Medical Plaza | 2 | They gave her medication/pills for the dizziness. | 1 | 0 |
| Male | 41-60 | 2,4-D Amine 60 SL, Amistar Top 32.5 SC, Diazi2n 60 EC, Karate Zeon 5 CS, Kung Fu 2.5 EC | The chemical affected his eyes and to use goggles and to protect his eyes. | Dr Briceño Clinic (Chetumal) | More than 5 | Doctors gave him eye drops to cleanse his eyes. He stated the eye drops really help the burning and swelling of eyes. | 1 | 3 |

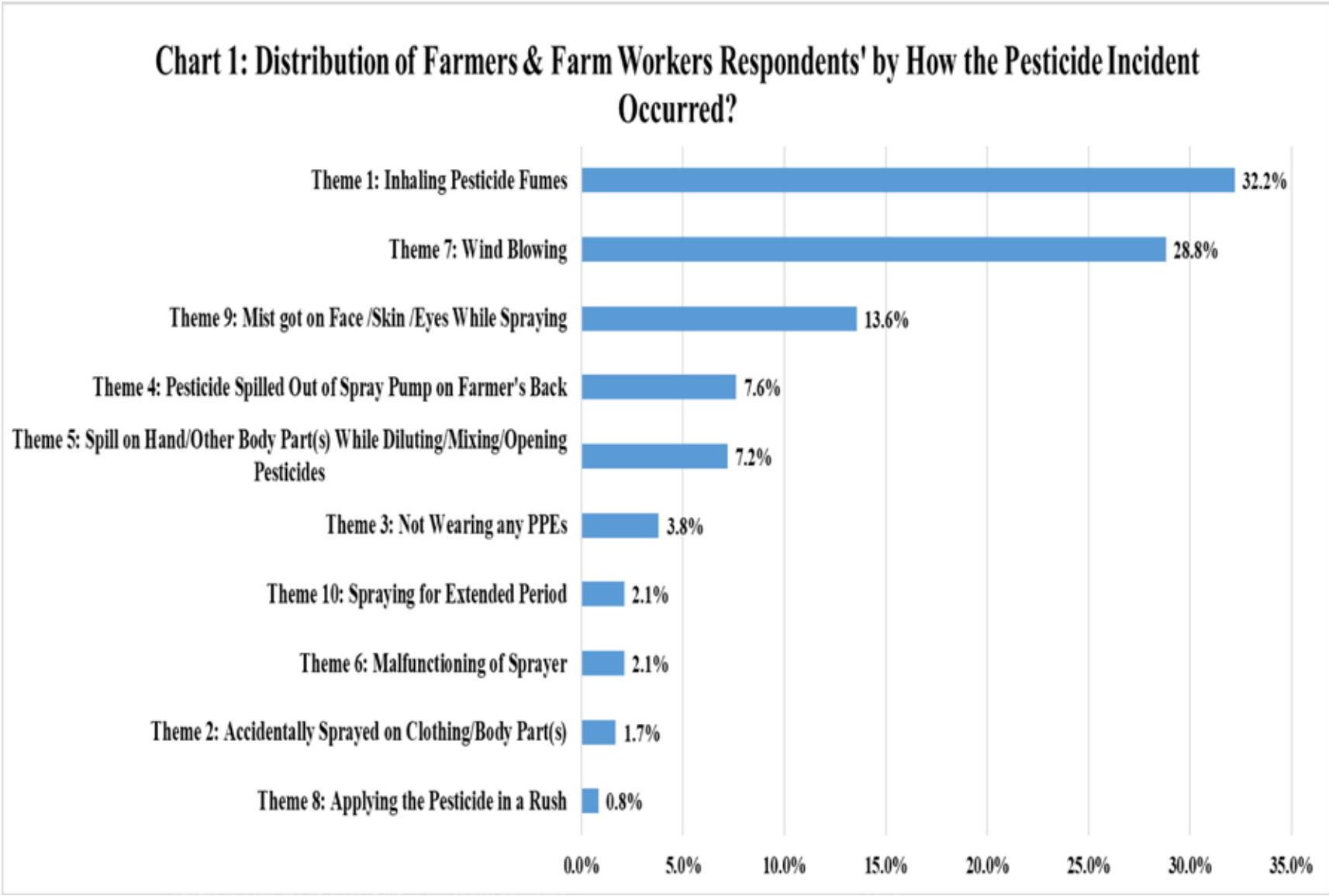


Chart 1: Distribution of Farmers & Farm Workers Respondents' by How the Pesticide Incident Occurred?
Theme 1: Inhaling Pesticide Fumes
32.2%
Theme 7: Wind Blowing
28.8%
Theme 9: Mist got on Face /Skin /Eyes While Spraying
13.6%
Theme 4: Pesticide Spilled Out of Spray Pump on Farmer's Back
7.6%
Theme 5: Spill on Hand/Other Body Part(s) While Diluting/Mixing/Opening Pesticides
7.2%
Theme 3: Not Wearing any PPEs
3.8%
Theme 10: Spraying for Extended Period
2.1%
Theme 6: Malfunctioning of Sprayer
2.1%
Theme 2: Accidentally Sprayed on Clothing/Body Part(s)
1.7%
Theme 8: Applying the Pesticide in a Rush
0.8%
0.0%
5.0%
10.0%
15.0%
20.0%
25.0%
30.0%
35.0%

**Table 11: Distribution of Farmers and Farm Workers Sample Respondents by Which ones of the following best summarizes what caused the pesticide poisoning incident**

| Causes of Pesticide Poisoning Incident | Frequency | Percent |
|---|---|---|
| Wind blew spray mist on sprayman during field application | 74 | 49.3% |
| Spray mist contacted sprayman during field application (wind not involved) | 27 | 18.0% |
| During application, pesticide leaked from spray equipment onto sprayman | 21 | 14.0% |
| While mixing pesticide, person was affected by pesticide vapours (fumes) | 18 | 12.0% |
| Bystander not involved in pesticide use was affected during mixing, or during / after application | 16 | 10.7% |
| Splashed/spilled pesticide on self while mixing/handling | 12 | 8.0% |
| Wind blew pesticide granules or powder on the person | 5 | 3.3% |
| Hand or glove contaminated with pesticide contacted other body parts | 2 | 1.3% |
| Skin was contaminated with pesticide when applying with a bucket | 2 | 1.3% |
| **Total** | **150** | **100.0%** |

Note Sum of each frequency and percent value does not equal to respective Totals shown (i.e. 150 instead of 177 and 100.0% instead of 118.0%) since a respondent can select more than one cause of pesticide poisoning incident.

**Table 12: Distribution of Farmers and Farm Workers Sample Respondents by "Why were you applying pesticides in windy conditions"**

| Reasons for Applying Pesticides in Windy Conditions | Frequency | Percent |
|---|---|---|
| Not windy when I started | 39 | 54.9 |
| The pest problem was urgent | 32 | 45.1 |
| Wind was blowing but I did not expect it would be a problem | 25 | 35.2 |
| I was instructed to spray at that time (someone else's decision) | 8 | 11.3 |
| No particular reason | - | 0.0 |
| Other | 4 | 5.6 |
| **Total** | **71** | **100.0** |

Note that 71 out of the 150 respondents were eligible to answer this question. Sum of each frequency and percent value does not equal to respective Totals shown (i.e. 71 instead of 108 and 100.0% instead of 152.1%) since a respondent can select more than one reason for applying pesticides in windy conditions.

**Table 13: Distribution of Farmers and Farm Workers Sample Respondents by Which of the following protective clothing were you wearing at the time of the incident?**

| Protective Clothing Worn at the Time of the Incident | Frequency | Percent |
|---|---|---|
| Long Pants | 110 | 73.3% |
| Long Sleeve Shirt | 105 | 70.0% |
| Water Boots | 103 | 68.7% |
| Rubber Gloves | 42 | 28.0% |
| Regular Dust Mask (Ineffective or Unsuitable PPE) | 39 | 26.0% |
| Scarf or Cloth Over Nose & Mouth (Ineffective or Unsuitable PPE) | 24 | 16.0% |
| Spray Mask | 23 | 15.3% |
| Shoes/Regular Boots | 21 | 14.0% |
| Coverall/Overall | 20 | 13.3% |
| Goggles | 20 | 13.3% |
| Respirator With Cartridges | 18 | 12.0% |
| Eyeglasses | 10 | 6.7% |
| Dust Mask With Pesticide Absorbing Particles (Single Use) | 8 | 5.3% |
| Waterproof Apron | 6 | 4.0% |
| Other | 31 | 20.7% |
| T-Shirt | 1 | 0.7% |
| None | 30 | 20.0% |

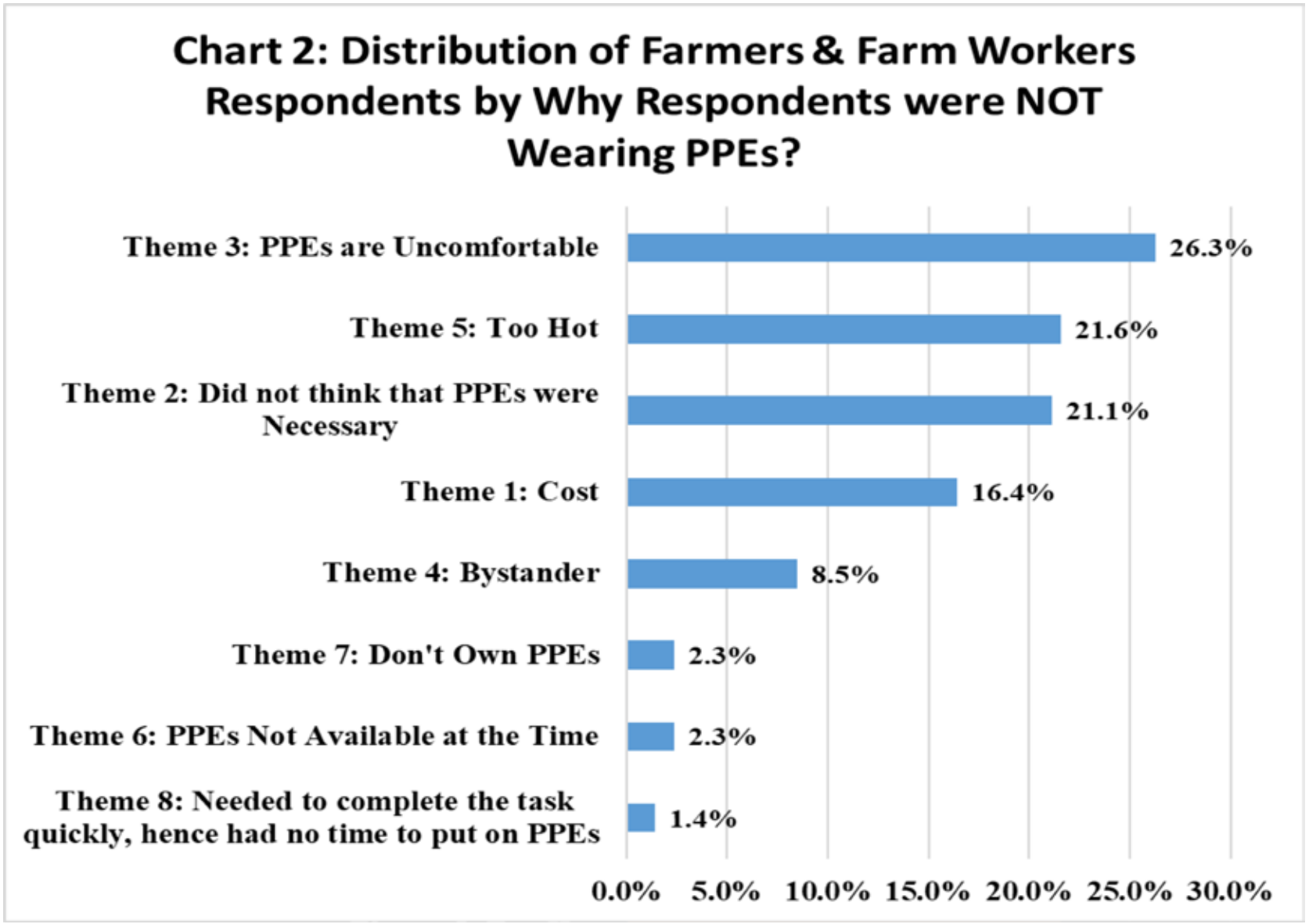


Chart 2: Distribution of Farmers & Farm Workers Respondents by Why Respondents were NOT Wearing PPEs?
Theme 3: PPEs are Uncomfortable
26.3%
Theme 5: Too Hot
21.6%
Theme 2: Did not think that PPEs were Necessary
21.1%
Theme 1: Cost
16.4%
Theme 4: Bystander
8.5%
Theme 7: Don't Own PPEs
2.3%
Theme 6: PPEs Not Available at the Time
2.3%
Theme 8: Needed to complete the task quickly, hence had no time to put on PPEs
1.4%
0.0% 5.0% 10.0% 15.0% 20.0% 25.0% 30.0%

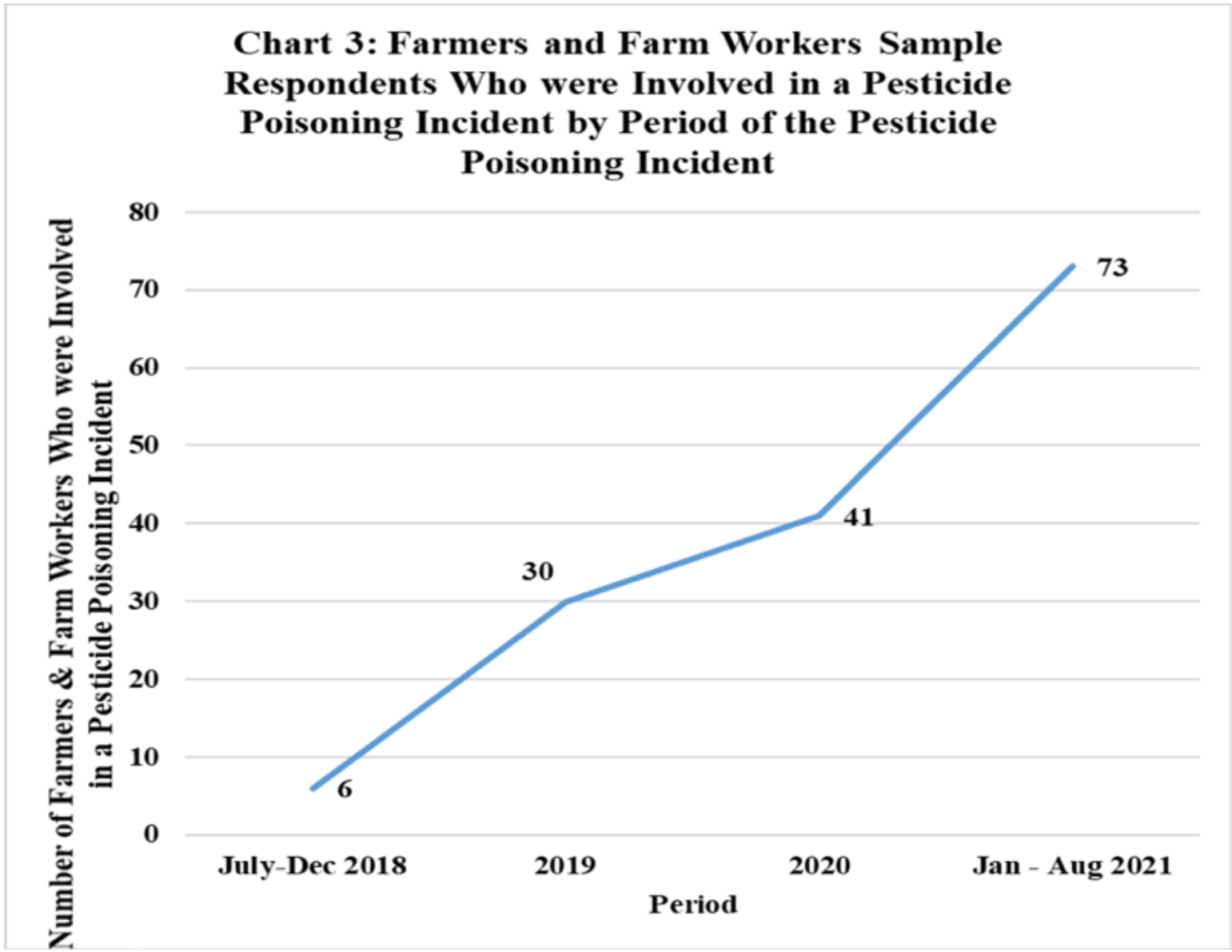


Chart 3: Farmers and Farm Workers Sample Respondents Who were Involved in a Pesticide Poisoning Incident by Period of the Pesticide Poisoning Incident
Number of Farmers & Farm Workers Who were Involved in a Pesticide Poisoning Incident
80
70
60
50
40
30
20
10
0
6
30
41
73
July-Dec 2018
2019
2020
Jan - Aug 2021
Period

**Table 16: Distribution of Farmers and Farm Workers Sample Respondents by Pesticide Mixture or Product that Respondents were Exposed to During Pesticide Poisoning Incident, Duration of the Pesticide Exposure Period & Length of Time Harmful Effects were Observed After Exposure.**

| Selected Characteristics | Frequency | Percent |
|---|---|---|
| **Total** | **150** | **100.0** |
| **Pesticide Mixture or Product that Respondents were Exposed to During Pesticide Poisoning Incident** | | |
| Diluted Mixture | 122 | 81.3 |
| Concentrated Commercial Product | 15 | 10.0 |
| Both | 10 | 6.7 |
| Not Sure/ Cannot Recall | 3 | 2.0 |
| **Duration of the Pesticide Exposure Period** | | |
| 1 to 2 Hours | 53 | 35.3 |
| Less Than 1 Hour | 44 | 29.3 |
| Half Day | 37 | 24.7 |
| 1 Day | 9 | 6.0 |
| More Than 1 Day | 7 | 4.7 |
| **Length of Time Harmful Effects were Observed After Exposure** | | |
| Almost Immediately | 80 | 53.3 |
| 1 to 2 Hours | 34 | 22.7 |
| At the End of the Same Day | 21 | 14.0 |
| Half a Day | 11 | 7.3 |
| The Next Day | 4 | 2.7 |

**Table 17: Distribution of Farmers and Farm Workers Sample Respondents by 19.) Which of the following activities at the time of exposure were you involved in (INTERVIEWER: Record those that apply)**

| Activities at the Time of Exposure were Respondent Involved in (INTERVIEWER: Record those that apply): | Frequency | Percent |
|---|---|---|
| Application in Field | 118 | 71.5 |
| Mixing Pesticide | 24 | 14.5 |
| Application Around or Near House, Including Backyard Garden | 7 | 4.2 |
| Loading Pesticide into Sprayer | 3 | 1.8 |
| Application in House (Household Pests) | 3 | 1.8 |
| Vector Control Application (Mosquito Fogging, etc.) | 1 | 0.6 |
| Application to Livestock (Control of Animal Ticks, etc.) | 0 | 0.0 |
| Standing/Working in or Near a Field During or After Pesticide Application | 0 | 0.0 |
| Other | 9 | 5.5 |
| **Total** | **165** | **100.0** |

Note: Sum of each frequency and percent value does not equal to respective Totals shown (i.e. 165 instead of 150 and 100.0% instead of 110%) since a respondent can select more than one option of the Activities that the Respondent was Involved in at the Time of Exposure.

## Table 19: Distribution of Farmers & Farm Workers From Ministry of Health & Wellness BHIS Database by Selected Characteristics

| Year | Health Facility | Sex | Age Group | Pesticide/ Pesticide Mixture | Poisoning Symptoms | Days in Hospital | Description of Pesticide Poisoning Incident |
|---|---|---|---|---|---|---|---|
| 2018 | Northern Regional Hospital | Male | 21-40 | 2-4D Herbicide | Nausea, vomiting, painful swallowing | 2 | Accidental poisoning by and exposure to pesticides, farm, during unspecified activity |
| 2019 | Independence Polyclinic | Male | Over 60 | Gramoxone | Vomiting blood | 5 | Accidental poisoning by and exposure to pesticides, farm, during unspecified activity |
| 2020 | Southern Regional Hospital | Male | 21-40 | Gramoxone | Vomiting, Burning sensation in throat, abdominal pain | 2 | Accidental poisoning by and exposure to pesticides, unspecified place, during unspecified activity |
| 2020 | Punta Gorda Hospital | Male | 21-40 | Helosate | Vomiting | 0 | Accidental poisoning by and exposure to pesticides, home, during unspecified activity |
| 2020 | Northern Regional Hospital | Male | Over 60 | Methylsulfinyl Pyrazol | Vomiting, Gastric discomfort, Shortness of Breath, Nausea | 2 | Accidental poisoning by and exposure to pesticides, home, while engaged in leisure activity |
| 2019 | Northern Regional Hospital | Male | Over 60 | Paraquat | Mild tongue discomfort | 0 | Accidental poisoning by and exposure to pesticides, farm, while working for an income |
| 2020 | San Ignacio Community Hospital | Female | 21-40 | Unspecified herbicide, not ingested, neighbor was spraying yard and fumes caused reaction | Dizziness, Nausesa, Vomiting | 0 | Accidental poisoning by and exposure to pesticides, home, during unspecified activity |
| 2018 | Southern Regional Hospital | Female | 21-40 | Unspecified pesticide | Weakness, burning sensation in stomach | 1 | Accidental poisoning by and exposure to pesticides, home, while engaged in other specified activities |
| 2018 | Independence Polyclinic | Male | 21-40 | Unspecified pesticide | Vomiting | 0 | Accidental poisoning by and exposure to pesticides, farm, while engaged in other specified activities |
| 2019 | Karl Heusner Memorial Hospital | Male | 21-40 | Unspecified pesticide | Unspecified | 1 | Accidental poisoning by and exposure to pesticides, other specified places, while engaged in other types of work |
| 2018 | Northern Regional Hospital | Male | 41-59 | Unspecified pesticide, not ingested, reaction after skin contact after fumigation | Itchiness | 1 | Accidental poisoning by and exposure to pesticides, farm, during unspecified activity |

# Comparing BHIS Data to the Survey

- In analyzing the reported pesticide used, only Gramoxone and 2,4-D Herbicide were noted in both the survey and the BHIS database. In the BHIS database, five (5) of the 11 reported incidents had an unspecified pesticide listed; hence we don't know which pesticide caused the poisoning incident. On the other hand, for the survey data, the name of the pesticide was a requirement of the survey.

## *How did pesticide poisoning affect females regarding pesticide, symptoms, severity, and treatment?*

- It was found that nine (9) females were affected by pesticide poisoning in Belize for the period July 2018 to August 2021 . Most (55.6%) of the nine (9) females were 40 years of age or younger (usual child-bearing age), while 44.6% were over 40 years old.

- The majority of the female pesticide incidents occurred via inhalation when these females were around the farmers or farm workers while spraying the farmyard.

- The pesticides that affected these nine (9) females more often were Malathion and 2,4-D Amine 60 SL pesticides; each of these pesticides affected two females.

## *How did pesticide poisoning affect females regarding pesticide, symptoms, severity, and treatment?*

- Furthermore, none of these pesticides that affected the females involved in the pesticide poisoning cases were from the Class I Toxicity group.

- These nine (9) females affected by pesticide poisoning experienced the most common symptoms of dizziness and headaches. The most common type of treatment that these nine females received were: Self Treatment (4) followed by Nothing/No Action (3), Went to a Private Doctor (1), and Washed the chemical off immediately (1).

***What Personal Protective Equipment were FFW victims of inhalation pesticides poisoning wearing when working with pesticides on the farm?***

- Because the reported major route of pesticide poisoning was by inhalation, there was a review of the PPE being worn to protect from inhalation at the time of those incidents. The relevant items reported were:

  i. Those recommended for inhalation protection - (a) "respirator with cartridges", of which 10 inhalation incidents still occurred (11%), or (b) "dust mask with pesticide absorbing particles (single use)" with 4 incidents (4%).

  ii. Those providing some protection - spray mask, with 14 incidents (15%) reported.

  iii. Those not recommended/not effective against inhalation - (a) "regular dust mask" had 22 incidents (24%); (b) scarf or cloth over nose and mouth had 17 incidents (19%).

- Kindly note that 15 or 16.3% of the 92 FFW victims of inhalation poisoning were wearing "No PPE". In general, it seems that FFW victims of inhalation poisoning were wearing more ineffective PPEs than effective PPE when working with pesticides on the farm. It is a alarming that 15% of the cases occurred although recommended inhalation protection was being used; this needs to be addressed.

## *Does suitable Personal Protective Equipment always work for FFW when they work with pesticides?*

- The PPEs are working well as there were only 2 or 1.3% of all 150 pesticide poisoning victims were wearing all the PPE (i.e., Rubber Gloves, Coverall / Overall, Goggles, Respirator with Cartridges, Water Boots, Long Sleeve Shirt & Long Pants)

- For a future study, it would be good to determine how these two victims were still affected by the pesticides when they wore all PPEs. Perhaps it may be due to improper use of PPEs or a defect in the PPEs.

- Notable was the fact that 14 persons reportedly were poisoned by inhalation despite wearing their recommended respirator with cartridges (10) and dust masks with pesticide-absorbing particles (4).

- This requires further investigation by the authority

## *Did the Class I toxicity group (most toxic pesticides) affect Farmers and Farmworkers in Belize?*

- We found that each pesticide within the Class I toxicity pesticides group except for Folater and Quickphos affected Farmers and Farm Workers.

- The predominant pesticide from the Class I toxicity pesticides group that affected Farmers and Farmworkers in Belize was Vydate 24 SL, followed by Lannate 21.6 SL, Lannate 90 SP, and Lash 90 SP

***What are the incidents of the Farmers and Farmworkers in Belize victims experiencing pesticide poisoning symptoms "extremely severe / very serious problem" but they did not seek medical attention in terms of pesticide, symptom, the treatment used rather than medical attention?***

There were 96 of the 150 FFW in the survey who were victims experiencing pesticide poisoning symptoms "extremely severe / very serious problem."

Of these 96 victims: self-treatment: 34.4% of these victims

- "I continued spraying, and after I had finished, I washed the chemical off,"34.4%
- I washed the chemical off immediately,"26.0%
- "Rested / Stopped Using the Pesticide,"17.7%, and
- "Nothing / No Action" accounting for, 7.3%.

## In terms of *symptoms*

- Headache, Skin Irritation/Itching, Skin Burns,
- Eye Irritation / Burning, Nausea, Sneezing,
- Dizziness, Excessive Sweating, Skin Rash,
- Vomiting, and Tightness of Chest / Asthma

## In terms of *pesticides*

- The top five (5) most common pesticides that were being used during the pesticide exposure incidents by the Farmers and Farmworkers who did not seek medical attention but experienced extreme or severe symptoms **were2,4-D Amine 60 SL, Gramoxone 20 SL, Newmectin 1.8 EC, Pro-Quat 20 SL, Karate Zeon 5 CS**

***Did Farmers and Farmworkers know the health hazards of Class I toxicity pesticides and those pesticides in incidents that caused "extremely severe / very serious" symptoms used on the farm?***

- It was found that most (54.9%) Farmers and Farmworkers either did not know (7.0%) or were not sure (47.9%) whether the 26 pesticides that belonged to the Class I toxicity pesticides group and those pesticides in incidents that caused "extremely severe / very serious" symptoms used on the farm were a health problem. This tells us that majority of Farmers and Farmworkers still do not know enough of the health hazards of the pesticides used on their farms.

- The top three (3) pesticides that Farmers and Farmworkers were most knowledgeable of in terms of pesticides belonging to the Class I toxicity pesticides group and pesticides that were in incidents that caused "extremely severe / very serious" symptoms used on the farm were

  - Gramoxone 20 SL,
  - 2,4-D Amine 60 SL and
  - Lannate 21 with scores of 80.0%, 78.5%, and 69.2% respectively.

# CONCLUSION

- The survey revealed that the farmers interviewed had experienced mild to severe reactions from pesticide usage in the field. Hence, measures need to be implemented to enhance farmers' and farm workers' knowledge of all the pesticides in the list of the Class I Toxicity so that they would be aware of the most toxic pesticides available in the market.

- From the list of pesticides reported by the farmers, none of these pesticides that made this top 10 list were from the Class I Toxicity (most toxic pesticides) group. The pesticides from the Class I Toxicity group involved in the incident were: Vydate 24 SL, Lannate 21.6 SL, Lannate 90 SP, and Lash 90 SP and were ranked $17^{th}$, $19^{th}$, $20^{th}$, and $26^{th,}$ respectively. Hence, farmers would need more education on the list of Class I Toxicity so that they would be aware of the most toxic pesticides available in the Belizean market. Furthermore, the data indicates that FFW respondents are not frequently using pesticides in the Class I Toxicity group, which is a good farming practice for safety reasons.

# CONCLUSION (CONTINUATION)

- The data also suggest that too many FFW combined many pesticides for farm work purposes, thereby risking contamination and poisoning by mixing multiple pesticides simultaneously. The Pesticide Control Board (PCB) and the Ministry of Agriculture (MOA) will need to address this problem so that mixing pesticides to do farm work will cease or be minimized.

- The study found that Self Treatment was the most predominant action taken when respondents felt the effects of the pesticide accounting for 53.3% of all respondents, while "Went to the Private Doctor" was the least predominant action taken when respondents felt the effects of the pesticide accounting for 0.7% of respondents. This data suggest that FFW will only visit the doctor if the effects of the pesticides experience a severe health problem. The researcher believes that Farmers' and Farmworkers' reluctance to visit the doctor when they have a health problem from the effects of the pesticides may be due to the proximity of medical facilities and the medical expenses for being treated by a doctor.

# CONCLUSION (CONTINUATION)

- The survey revealed that FFWs are not wearing their Personal Protective Equipment (PPEs), especially masks when working on their farms. A respondent got affected by the pesticide when washing the respondent's clothing or when the farmer was in close contact with people after using pesticide at the farm. These incidents can be reduced by sharing best practice measures with the Farmers and Farm Workers.

- The least dominant causes of the pesticide poisoning incident that the FFW respondents reported were wind blew pesticide granules or powder on the person, hand, or glove contaminated with pesticide contacted other body parts, the skin was contaminated with pesticide when applying the pesticide with a bucket.

- The results indicated a need for FFW to receive practical training on using a sprayer when working on a farm, especially when the weather is windy. Also, farmers need to keep track or be constantly aware of the weather and, when possible, do farm work that involves spraying pesticides during times that are not windy.

# CONCLUSION (CONTINUATION)

- Furthermore, in general, the incidence of pesticide poisoning in Belize has been trending upwards, and the most significant year over year increase is in the 2020 to 2021 period when the Poisoning Incident among FFW was almost doubled (i.e., 1.8 times) from 41 cases in 2020 to 73 cases in 2021 . Kindly note that the increase in the incidence of pesticide poisoning in Belize for 2021 is even more significant as the period for 2020 was a full year while the period for 2021 was only for the period January to August.

- The majority of FFW respondents stated that they could read and understand the label on the pesticide. In comparison, 16.0% were not able to read and understand the label on the pesticide, and 10.0% were not sure or could not recall if they were capable of reading and understanding the label on the pesticide.

# RECOMMENDATIONS

1. The Pesticide Control Board (PCB) and the Ministry of Agriculture (MOA) must ensure that measures are implemented to enhance farmers' and farm workers' knowledge of all the pesticides in the list of the Class I Toxicity so that they would be aware of the most toxic pesticides available in the market.

2. The PCB and the MOA will need to educate FFW on mixing pesticides practices (e.g., acceptable vs. harmful or wasteful practices). This can certainly address the problem of harmful and wasteful mixing of pesticides practices to do farm work in Belize.

3. The results indicate a need for FFW to receive practical training on using a sprayer when working on a farm, especially when the weather is windy. Also, farmers need to keep track or be constantly aware of the weather and avoid spraying on windy days. Hence, the PCB and the MOA need to educate FFW on planning their workdays using weather and climate information from various sources.

# RECOMMENDATIONS (CONTINUATION)

4. The PCB and the MOA must educate the FFW on the importance of PPE use to protect FFW health. Moreover, training must also be focussed on getting the FFW to experience behavioural change that conforms to best practices of wearing PPEs when using pesticides at their respective farms.

5. The PCB and MOA must aggressively advocate for OSH standards to be adopted by Belize and ensure that employers and Farmers comply with OSH's general PPE requirements.

6. The PCB and MOA must compel employers or Farmers to always provide PPEs to their workers and ensure its proper use when work practice and administrative controls are not feasible or do not provide sufficient protection.

# RECOMMENDATIONS (CONTINUATION)

8. The PCB and the MOA must train the FFW on the proper use of PPE to know:
    - When it is necessary;
    - What kind is necessary;
    - How to properly put it on, adjust, wear and take it off (If the personal protective equipment does not fit properly, it can make the difference between being safely covered or dangerously exposed);
    - The limitations of the equipment and
    - Proper care, maintenance, useful life, and disposal of the equipment

# RECOMMENDATIONS (CONTINUATION)

9. The PCB and MOA must implement a PPE program that should address:
    - the hazards present;
    - the selection, maintenance, and use of PPE;
    - the training of employees;
    - and monitoring of the program to ensure its ongoing effectiveness.

10. The Pesticide Control Board needs to review all pesticides identified by the survey to determine if poisoning incidents warrant restricting or banning the most toxic ones.

# RECOMMENDATIONS (CONTINUATION)

11. The PCB and the MOA need to constantly urge or compel FFW to report poisoning incidents and seek medical attention. This could be done using technology (e.g., apps software).

12. The clinic goes to the FFW patients if the patients cannot come to the clinic. This will change the behavioural practice or habit of FFW to only visit the doctor if the effects of the pesticides experience a severe health problem due to the proximity of medical facilities and high medical expenses for being treated by a doctor. Hence, the PCB and the MOA will need to partner with the MOH, Pan American Health Organization, Social Security Board, and other NGOs to adapt best practices in digital health or eHealth or telemedicine and related methods of providing health care such as: mobile clinics where medical practitioners or Floating Doctors travel to remote communities with poor access to care to provide primary care and emergency care services.

# RECOMMENDATIONS (CONTINUATION)

13. Invest and adopt Telehealth services where medical care is provided at a distance which means people in remote areas with limited access to healthcare can get the medical attention they need. This also saves time, money and travel for both doctors and FFW patients.

14. Invest and use mobile apps dedicated to health for both healthcare professionals and FFW patients as will turn our smartphones into personal trainers, sleep monitors, diagnostic, devices, etc.

15. Invest and use mobile wearable technology (aka wearables) - includes smart clothing and accessories such as wristbands, glasses and watches to monitor and collect information on our health and physical condition. These digital health or eHealth services can provide effective and quality medical care to FFW patients in remote settings who have been poisoned by pesticides among other injuries or illnesses that occur while working at the farms.

# RECOMMENDATIONS (CONTINUATION)

16. Invest in Agriculture Technology solutions such as Autonomous agriculture robots that can work for 24 hours a day since using agriculture robots will:

   – help reduce the time FFW spend laboring out in the harsh conditions of the field which include the pesticides spraying among many other labor intensive and dangerous tasks at the farm.

   – eliminate or at least minimize pesticides poisoning incidents in Belize

# RECOMMENDATIONS (CONTINUATION)

17. Invest in Smart vehicles (e.g. automated tractors, harvesters, rice transplanters, etc.) that harness the advantages of data to schedule the daily, weekly, and seasonal tasks necessary to keep a working farm operating among other valuable benefits. A useful application would be using past planting season's data to inform this year's planting schedule, right down to spraying the exact amount of pesticides and herbicides required – reducing time and wastage on chemicals and other resources.

18. Invest in Industrial drones that can provide end-to-end surveillance solutions for monitoring crop growth and other agriculture monitoring needs. For example, Industrial Drones can be used by FFW to spray pesticides at the farm especially at hard to reach places. Kindly note that the latter three (3) recommendations can eliminate pesticides poisoning incidents in Belize altogether since machines instead of FFW will be out in the farm spraying the pesticides doing so at a significantly more effective and efficient manner.

# THANK YOU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CPI
Consumer Price Index

# STATISTICAL INSTITUTE OF BELIZE

CPI release for the month of: February 2022 • Published on: March 30th, 2022

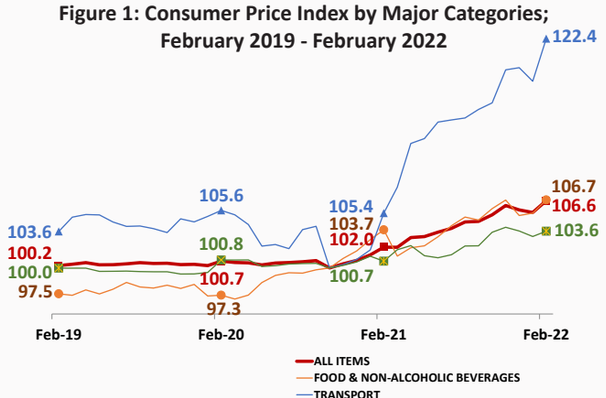
## CONSUMER PRICES UP 4.5% IN FEBRUARY 2022: HIGHER PRICES FOR FUELS, FOOD, LPG, RESTAURANT SERVICES, HOUSEHOLD CLEANING PRODUCTS, AND WOMEN'S CLOTHING.

### NATIONAL INFLATION RATE FOR FEBRUARY 2022:

### All-Items:

The most recent results from the Statistical Institute of Belize's monthly Consumer Price Index (CPI) survey show that for the month of February 2022, the All-Items CPI, which summarizes price levels across all categories of goods and services, stood at 106.6, up from 102 recorded for February 2021 (see Figure 1). This indicated that the country experienced an overall national inflation rate[1] of 4.5 percent on the cost of goods and services regularly purchased by Belizean households. This was the result of higher costs for motor vehicle fuels, food, liquefied petroleum gas (LPG), restaurant services, household cleaning and maintenance products, and women's clothing.

**Figure 1: Consumer Price Index by Major Categories; February 2019 - February 2022**




Source: Statistical Institute of Belize, 2022

### Transport:

The 'Transport' category saw the most dramatic increase, rising by 16.2 percent in February 2022 (see Figure 2). Within this category, all fuel types were up by well over 20 percent compared to February of last year. At the pump, premium gasoline registered the highest increase, with the average price per gallon rising by $2.74, from $10.02 in February 2021 to $12.76 in February 2022. Regular gasoline was up by $2.38, from $9.91 to $12.29, while diesel rose by $2.20, from $9.41 in February of last year to $11.60 in February of this year (see Table 1). Additionally, passenger transport by bus rose by 5.6 percent, as fare increases were seen across various short bus runs in the Belize, Corozal and Toledo districts, while the cost of new motor vehicles were up by 8.1 percent.

### Food and Non-Alcoholic Beverages:

In comparison to February 2021, the 'Food and Non-Alcoholic Beverages' category saw an overall increase of 3.8 percent for the month of February 2022 (see Figure 2). While prices rose across all types of basic food items, the increase in this category was mainly driven by higher prices for meats, cereal products, seafood, and cooking oils. Products that saw the most notable price changes for the month included pigtails, chicken wings, rice, coconut oil, vegetable oil, limes, and Irish potatoes. Nonetheless, prices for fresh vegetables, which had increased considerably throughout 2021, were down by 3.1 percent compared to February of last year, with decreases recorded for items such as cabbages, red kidney beans, watermelons, and sweet peppers (see Table 1).

### Housing, Water, Electricity, Gas and Other Fuels:

The category of 'Housing, Water, Electricity, Gas and Other Fuels', saw an overall increase of 2 percent for the month (see Figure 2). As has been the case for the past several months, this was attributable to higher LPG prices, which were up by 21.2 percent

**Table 1: Average Prices of Selected Foods and Fuel (BZ $); February 2021 and February 2022**

| Item | Unit of Measurement | Average Prices | | % Change |
|---|---|---|---|---|
| | | February 2021 | February 2022 | |
| Rice | 1 Lb | $1.37 | $1.49 | 8.7% |
| Chicken Cuts | 1 Lb | $3.05 | $3.23 | 6.1% |
| Chicken, Legs | 1 Lb | $3.15 | $3.24 | 2.8% |
| Chicken, Wings | 1 Lb | $4.64 | $5.12 | 10.3% |
| Chicken, Breast | 1 Lb | $3.80 | $3.90 | 2.8% |
| Whole Chicken | 1 Lb | $2.78 | $2.97 | 6.7% |
| Pigtail | 1 Lb | $4.41 | $7.15 | 62.1% |
| Coconut Oil | 1 L | $12.66 | $14.64 | 15.6% |
| Vegetable Oil | 1 L | $3.50 | $4.65 | 33.1% |
| Flour | 1 Lb | $1.05 | $1.09 | 3.5% |
| Cake Baking Mix | 15.25 Oz | $5.10 | $4.90 | -4.0% |
| Cake | 1 Slice | $4.28 | $4.40 | 2.7% |
| Banana | 1 Unit | $0.15 | $0.15 | 3.5% |
| Pineapple | 1 Lb | $1.29 | $1.31 | 1.3% |
| Limes | 1 Unit | $0.35 | $0.41 | 18.5% |
| Orange | 1 Unit | $0.16 | $0.17 | 7.0% |
| Watermelon | 1 Lb | $0.82 | $0.69 | -15.6% |
| Cabbage | 1 Lb | $1.91 | $1.44 | -24.6% |
| Sweet Pepper | 1 Lb | $3.40 | $2.90 | -14.6% |
| Onion | 1 Lb | $2.29 | $2.14 | -6.5% |
| Irish Potatoes | 1 Lb | $1.80 | $2.40 | 33.2% |
| Tomatoes | 1 Lb | $2.24 | $2.32 | 3.6% |
| Black Beans | 1 Lb | $2.54 | $2.46 | -3.1% |
| Red Kidney Beans | 1 Lb | $2.56 | $2.01 | -21.4% |
| Premium Gasoline | 1 Gallon | $10.02 | $12.76 | 27.4% |
| Regular Gasoline | 1 Gallon | $9.91 | $12.29 | 24.0% |
| Diesel | 1 Gallon | $9.41 | $11.60 | 23.4% |
| Liquified Petroleum Gas (LPG) | 100 Lbs | $109.90 | $133.16 | 21.2% |

Source: Statistical Institute of Belize, 2022

when compared to February of last year. The average cost of a hundred-pound cylinder of LPG rose by $23.26, from $109.90 in February 2021 to $133.16 in February 2022 (see Table 1). Also within this category, construction materials for household use were up by 14.2 percent. The effect of these increases overshadowed those of lower electricity tariffs, which were 3.5 percent lower than they were in the same month last year, and a 0.5 percent decline in home rental costs for the month.

### Furnishings, Household Equipment, and Routine Household Maintenance:

The 'Furnishings, Household Equipment, and Routine Household Maintenance' category recorded an inflation rate of 2.9 percent for February 2022 (see Figure 2). This was due, for the most part, to a 7.2 percent increase in prices for laundry products, soaps, and detergents along with a 2.2 percent rise in prices for bedroom furniture.

### Clothing and Footwear:

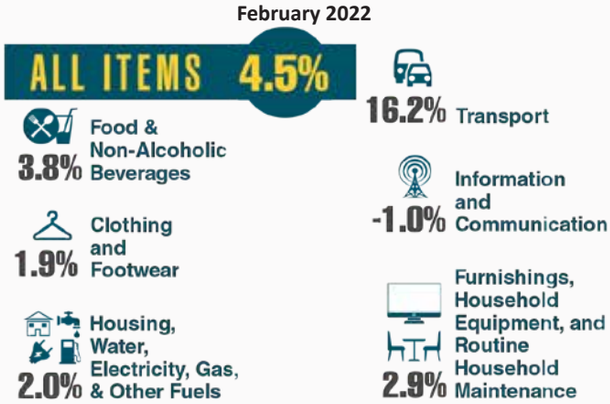
Prices for 'Clothing and Footwear' rose by 1.9 percent overall when compared to February 2021, as a result of higher prices for women's clothing and footwear (see Figure 2).

[1] The national inflation rate for the month measures the percent change in the CPI between February 2021 and February 2022.

## Information and Communication:

Prices for goods and services captured within the category of 'Information and Communication', on the other hand, saw a 1 percent decline overall for the month of February 2022 (see Figure 2), due mainly to lower prices for internet provision services, computers, laptops, tablets, and external storage devices.

**Figure 2: Inflation Rates for Selected Major Categories; February 2022**

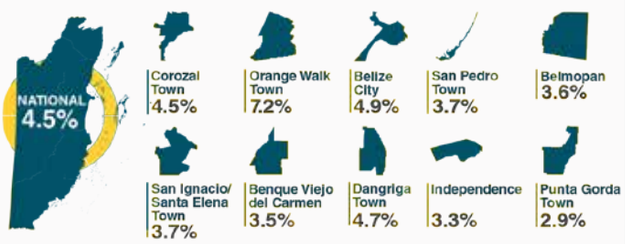



Source: Statistical Institute of Belize, 2022

## Inflation Rates by Municipality:

With an inflation rate of 7.2 percent, Orange Walk Town recorded the highest rate of increase in consumer prices for February 2022. Consumers in this town saw above average increases in prices for various food items, home rental costs, restaurant services, women's clothing, laundry products, soaps, detergents, and men's and women's haircuts. In contrast, Punta Gorda Town recorded the lowest inflation rate, with prices going up by 2.9 percent, as consumers in this town saw lower than average increases in prices for food items, restaurant services, and women's and girl's clothing (see Figure 3).

**Figure 3: Inflation Rates by Municipality (%); February 2022**




Source: Statistical Institute of Belize, 2022

## Month-Over-Month Inflation Rates:

While inflation rates are generally calculated as the percent change in prices for specific items between the current time period and the same period of the previous year, another useful measure for tracking short-term changes in consumer prices is the month-over-month or inter-monthly inflation rate[2], which measures the percent change in prices between the previous month and the current month.

Over the one-month period between January 2022 and February 2022, consumer prices increased by 1.1 percent on average (see Table 2). Prices within the 'Transport' category went up by 3.5 percent between January and February, with motor vehicle fuels increasing by 4.9 percent on average just over the one-month period. 'Food and Non-Alcoholic Beverages' rose by 1.2 percent, as a result of higher prices for fresh vegetables, fruits, meats, and cereal products. The 'Housing, Water, Electricity, Gas and Other Fuels' category increased by 0.5 percent over the one-month period, due to higher LPG prices and home rental costs, while prices for 'Restaurant and Accommodation Services' went up by 1.2 percent, as a result of higher hotel accommodation rates and prices for restaurant services.

**Table 2: Month to Month Inflation Rates by Category (%); February 2022**

| | February 2022 |
|---|---|
| **ALL ITEMS** | **1.1%** |
| Food and Non-Alcoholic Beverages | 1.2% |
| Alcoholic Beverages, Tobacco and Narcotics | 0.3% |
| Clothing and Footwear | 0.1% |
| Housing, Water, Electricity, Gas and Other Fuels | 0.5% |
| Furnishings, Household Equipment and Routine Household Maintenance | 0.5% |
| Health | 0.3% |
| Transport | 3.5% |
| Information and Communication | -0.9% |
| Recreation, Sport and Culture | 0.5% |
| Education Services | 0.0% |
| Restaurants and Accomodation Services | 1.2% |
| Insurance and Financial Services | -0.2% |
| Personal Care, Social Protection and Miscellaneous Goods and Services | 0.3% |

Source: Statistical Institute of Belize, 2022

## YEAR-TO-DATE INFLATION RATE:

The year-to-date or cumulative inflation rate[3] for the first two months of 2022, when compared to the same period in 2021, stood at 4.3 percent. This increase was driven mainly by higher prices for fuel, food, LPG, and restaurant services. The 'Transport' category, which was up by 16.2 percent, was the main driver of this rise in consumer prices during the period, reflecting higher costs for all types of motor vehicle fuels and for new motor vehicles. 'Food and Non-Alcoholic Beverages' rose by 3.1 percent, as a result of higher prices for meats, cereal products, seafood, and cooking oils. 'Housing, Water, Electricity, Gas and Other Fuels' had a cumulative inflation rate of 2 percent, mainly due to higher prices for LPG and construction materials for household use. The 'Restaurant and Accommodation Services' category was up by 4.9 percent, as a result of higher prices for restaurant services, while 'Furnishing, Household Equipment and Routine Household Maintenance' had a year-to-date inflation rate of 2.6 percent, reflecting higher prices for laundry products, soaps, and detergents (see Table 3).

**Table 3: Year to Date Inflation Rates by Category (%); February 2022**

| | February 2022 |
|---|---|
| **ALL ITEMS** | **4.3%** |
| Food and Non-Alcoholic Beverages | 3.1% |
| Alcoholic Beverages, Tobacco and Narcotics | 1.0% |
| Clothing and Footwear | 1.4% |
| Housing, Water, Electricity, Gas and Other Fuels | 2.0% |
| Furnishings, Household Equipment and Routine Household Maintenance | 2.6% |
| Health | 1.3% |
| Transport | 16.2% |
| Information and Communication | -0.5% |
| Recreation, Sport and Culture | 0.2% |
| Education Services | -0.1% |
| Restaurants and Accomodation Services | 4.9% |
| Insurance and Financial Services | -0.1% |
| Personal Care, Social Protection and Miscellaneous Goods and Services | 0.4% |

Source: Statistical Institute of Belize, 2022

[2] The month-over-month inflation rate measures the percentage change in prices between the previous month and the current month. It is useful for capturing short-term price changes but is also affected by seasonal price movements.

[3] The year-to-date inflation rate as of February 2022 measures the percent change in the average CPI for the first two months of 2021 compared to the average CPI for the first two months of 2022.

For more information contact **Data Dissemination Department** at telephone number **822-2207/2352** or e-mail at info@mail.sib.org.bz.
An Excel version of the tables contained in this release can be downloaded from our website at **www.sib.org.bz/statistics**

ET
External Trade

STATISTICAL INSTITUTE OF BELIZE

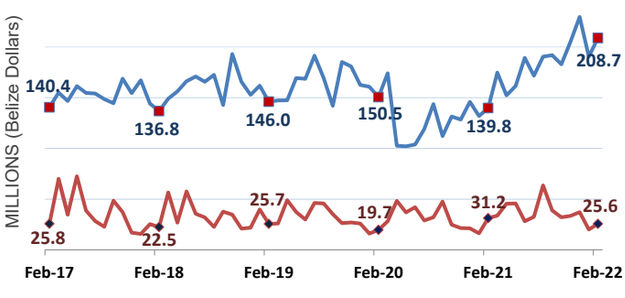
Trade release for the month of February 2022 • Published on March 30th, 2022

# IMPORTS UP 49.3%, DOMESTIC EXPORTS DOWN 18% IN DECEMBER 2021

## IMPORTS

**FEBRUARY 2022:** Belize's total imports for the month of February 2022 were valued at $208.7 million. This was a significant increase of 49.3 percent or $68.9 million from imports for February 2021, which were valued at $139.8 million.

**Figure 1: Monthly Gross Imports and Domestic Exports; February 2017 - February 2022**




Source: Statistical Institute of Belize, 2022

### *INCREASING CATEGORIES:*

Most commodity categories were up significantly in comparison to February of 2021, with the most notable increases being seen in 'Machinery and Transport Equipment', 'Commercial Free Zones', 'Manufactured Goods' and 'Mineral Fuels and Lubricants'.

#### Machinery and Transport Equipment

Imports of 'Machinery and Transport Equipment' more than doubled, rising by $24.7 million from $22.2 million to $46.9 million. This was largely on account of some high value purchases, including aircraft engines, buses, and non-telescoping discharge hoods, as well as increased imports of goods such as food slicers.

#### Commercial Free Zones

With heightened purchases of tennis shoes, cigarettes, and clothing, imports into the 'Commercial Free Zones' increased sharply by $19.4 million, from $16.5 million in February 2021 to $35.9 million in February 2022.

#### Manufactured Goods

Purchases of 'Manufactured Goods' rose by 50 percent or $9.9 million during the month, from $19.9 million to $29.8 million, owing to greater imports of items such as truck tires, carton boxes, and accessory organizers.

#### Mineral Fuels and Lubricants

The 'Mineral Fuels and Lubricants' category grew by 45 percent or $8.6 million, from $19.4 million in February of last year to $28 million in February of this year. This was largely the result of higher fuel prices on the world market, combined with greater imported quantities of bunker C and premium fuels.

#### Chemical Products

The 'Chemical Products' category rose by $3.3 million, from $14.5 million to $17.8 million, due to increased purchases of detergent powders and PVC pipes for the month.

#### Designated Processing Areas

Goods destined for the 'Designated Processing Areas' increased by $3.2 million for the month, from $1.6 million in February of 2021 to $4.8 million in February of 2022, on account of larger imports of disassembled drums and paper machinery.

#### Food and Live Animals

Increased food imports, particularly grocery items such as luncheon meats and margarine, boosted the 'Food and Live Animals' category by $1.5 million, from $21.1 million to $22.6 million.

#### Crude Materials

Imports of 'Crude Materials,' such as treated pine lumber and grass seeds, grew by $1.2 million during the month, from $1.3 million in February of last year to $2.4 million in February of this year.

### *DECREASING CATEGORIES*

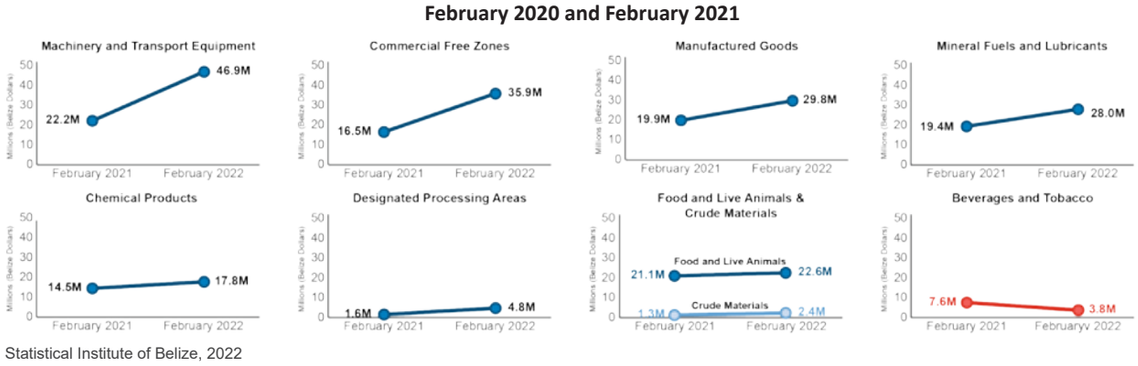
#### Beverages and Tobacco

The only significant reduction in imports for the month was seen in the 'Beverages and Tobacco' category, which fell by $3.8 million from $7.6 million in February 2021 to $3.8 million in February 2022, owing to a decline in imports of beer meant for re-exportation.

### FIRST TWO MONTHS OF THE YEAR:

Merchandise imports for the first two months of the year, January to February 2022, amounted to $399.2 million. This represented a 47 percent or $127.5 million increase from the same period last year, when goods valued at $271.6 million were imported.

**Figure 2: Composition of Gross Imports by Type; February 2020 and February 2021**




Source: Statistical Institute of Belize, 2022

### *INCREASING CATEGORIES:*

**Commercial Free Zones**

Goods destined for the 'Commercial Free Zones' were up by $41.5 million, from $36.9 million in 2021 to $78.4 million in 2022, as a result of bigger imports of footwear, cigarettes and bags.

**Machinery and Transport Equipment**

With increased imports of items such as food slicers, non-telescoping discharge hoods, aircraft engines, and motor vehicles, the 'Machinery and Transport Equipment' category rose by 62 percent or $31.3 million, from $50.5 million to $81.7 million.

**Mineral Fuels and Lubricants**

The 'Mineral Fuels and Lubricants' category climbed by $23.9 million during the period, from $31 million in 2021 to $54.9 million in 2022, owing to higher global fuel prices and increased imported quantities.

**Manufactured Goods**

Imports of 'Manufactured Goods' rose by a significant 43 percent or $16.6 million, from $38.7 million in the first two months of 2021 to $55.3 million in the first two months of 2022, due largely to high-value purchases such as cement clinkers, H beams, and truck tires.

**Chemical Products**

Purchases of 'Chemical Products', likewise, grew markedly during the month. This category went up by $11.7 million, from $27.4 million to $39.1 million, on account of heightened imports of fertilizers.

**Food and Live Animals**

The period also saw an increase in the 'Food and Live Animals' category when compared to the same period of 2021, with imports up by $6.3 million, from $35.7 million in 2021 to $41.9 million in 2022, as a result of larger purchases of grocery items such as luncheon meats and margarine.

**Designated Processing Areas**

Purchases of goods going into the 'Designated Processing Areas' went up by $3.2 million over the first two months of the year, from $5 million to $8.1 million, owing mainly to increased purchases of disassembled drums and paper machinery.

**Oils and Fats**

With bigger imports of cooking oils recorded during the period, the 'Oils and Fats' category rose by 55 percent or $1.7 million, from $3.1 million in 2021 to $4.8 million in 2022.

### *DECREASING CATEGORIES*

**Beverages and Tobacco**

The category of 'Beverages and Tobacco' was the only one to have seen a decrease over the period, with imports down by $10 million, from $15.7 million in the first two months of 2021 to $5.7 million in the first two months of 2022, due to reduced purchases of cigarettes and beer meant for re-exportation.

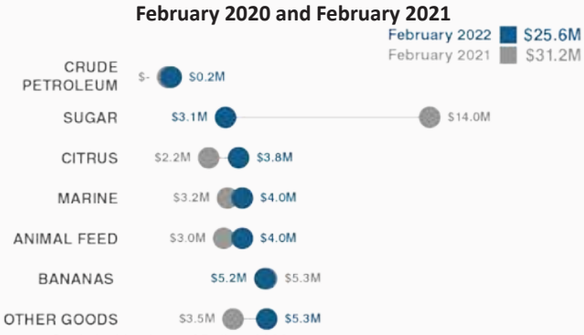
## DOMESTIC EXPORTS

**FEBRUARY 2022:** Total domestic exports for the month of February 2022 amounted to $25.6 million, down by 18 percent or $5.6 million when compared to exports for February 2021, which were valued at $31.2 million.

### *DECREASING CATEGORIES:*

Earnings from sugar exports were considerably lower than they were in February of last year, as there were no bulk shipments of this commodity during February of this year. Revenues from this product were down by $10.9 million or 80 percent, from $14 million in February 2021 to $3.1 million in February 2022, due to the smaller quantities of this product being exported during the month.

**Figure 3: Composition of Domestic Exports by Type; February 2020 and February 2021**




Source: Statistical Institute of Belize, 2022

### *INCREASING CATEGORIES:*

Notwithstanding the lower sugar earnings for the month, there were some increases recorded among the country's other exports. Revenues from citrus products were up significantly by 73 percent or $1.6 million, from $2.2 million in February of last year to $3.8 million in February of this year, as a result of greater quantities of orange concentrate and orange oil being exported. Earnings from animal feed grew by $1 million, from $3 million in February 2021 to $4 million in February 2022, while sales of marine products saw a slight increase of $0.7 million, from $3.2 million to $4 million, due largely to increased exports of lobster tails.

### *MAJOR DESTINATIONS:*

Earnings from the United Kingdom were down by $9.3 million, from $14.2 million in February 2021 to $4.9 million in February 2022, reflecting mainly the reduced exports of sugar to this country for the month. On the other hand, revenues from Central America went up by $1.4 million, from $3.1 million to $4.5 million, the result of a sharp increase in exports of corn gluten recorded for the month of February 2022. With increased sales of orange concentrate to CARICOM for February of this year, earnings from this region rose by $1.6 million, from $5 million to $6.6 million.

### FIRST TWO MONTHS OF THE YEAR:

Merchandise exports for the period January to February 2022 totaled $45.6 million. This represented a decline of 4 percent or $1.7 million from the $47.4 million in exports recorded for same period last year.

### *DECREASING CATEGORIES:*

Sugar was the only major export to record a significant decrease for the period, as there were no bulk shipments made during the first two months of this year. Earnings from this commodity were down by 55 percent or $8.4 million, from $15.3 million in 2021 to $6.8 million in 2022.

### *INCREASING CATEGORIES:*

Animal feed and citrus, on the other hand, saw improved earnings during the first two months of the year. Revenues from animal feed grew by almost 55 percent or $2.7 million, from $5 million in 2021 to $7.7 million in 2022. Earnings from citrus products were up by 23 percent or almost $1 million, from $4.1 million to $5 million, due largely to higher quantities of orange concentrate and orange oil being exported at improved prices.

**Figure 4: Composition of Exports by Destination; February 2022 (Millions of BZ Dollars)**


Source: Statistical Institute of Belize, 2022

For more information contact **Data Dissemination Department** at telephone number **822-2207/2352** or e-mail at info@mail.sib.org.bz.
An Excel version of the tables contained in this release can be downloaded from our website at **www.sib.org.bz/statistics**