Introduction of taxonomic sciences

Taxonomy is the science of naming, describing and classifying organisms and includes all plants, animals and microorganisms of the world by using morphological, behavioural, genetic and biochemical observations, taxonomists identify, describe and arrange species into classifications, including those that are new to science. Taxonomy identifies and enumerates the components of biological diversity providing basic knowledge underpinning management and implementation . Different kinds of animals, fungi and plants and microorganisms are called different ‘ species’. This reflects a real biological difference – a species is defined as a potentially interbreeding group of organisms that can produce viable offspring that themselves can interbreed. Thus animals of two different species, like a horse and a zebra, cannot interbreed, while animals of the same species can. Taxonomists provide unique names for species, labels that can help us find out more about them, and enable us to be sure that we are all talking about the same thing. Of course, there are names for organisms in many languages and this may will cause confuse when thus for this reason the Latin ‘ scientific’ name is given as a unique universal identifier. Biological classification is a crucial step in the taxonomic process, as it informs the user as to what the relatives of the taxon are hypothesized to be. There are some taxonomic ranks that need to be follows which are Domain, Kingdom, Phylum, Class, Order, Family, Genus, and Species. Nowadays as people start to realize the important of biodiversity, conservation work have becomes ever more politically important.

Why is Taxonomy Considered a Sciences?

The word science comes from the Latin “ scientia,” meaning knowledge. According to Webster’s New Collegiate Dictionary, the definition of science is the knowledge that gains through study or practice or knowledge that obtained and tested through scientific method. Science is actually a system of obtaining knowledge. This system uses observation and experimentation to describe and explain natural phenomena. Taxonomy is considered as a science because it is one of the field of biology sciences that involves the using of knowledge from others field such as cell biology, biochemistry, environment sciences and molecular biology. The Scientific Method is a logical and rational order of steps by which scientists come to conclusions about the world around them. The Scientific Method helps to organize thoughts and procedures so that scientists can be confident in the answers they find. Scientists use observations, hypotheses, and deductions to make these conclusions. A scientist will need to think through the various possibilities using the scientific Method to eventually come to an answer to your original question. The steps of the Scientific Method are: Observation, hypothesis, research and experimentation and conclusion. Taxonomic starts with the process of observation on the field, where the taxonomist searching for new species . Followed by hypothesis, which involve the process of sorting specimens to separate sets they believe represent species. Once the specimens are sorted the next job is to see whether or not they already have names. Followed by research and experiment process, which involve working through identification guides, reading descriptions written perhaps 200 years ago and borrowing named specimens from museums or herbaria to compare with the sample. Such comparison may involve external characters thus

taxonomist need to dissect internal structures, or even molecular analysis of the DNA. Then in conclusion, if there is no match then that means specimens may represent a new species. The taxonomist then has to write a description, including ways in which the new species can be distinguished from others, and make up a name for it, in a Latin format. The name and the description must then be properly published so that other taxonomists can see what has been done, and be able to identify the species themselves.

How Important is taxonomy in agrobiodiversity.

Why taxonomy? The impact of taxonomic work not only on the scientific community but the whole society including sustainable agriculture. Unfortunately, taxonomic knowledge is far from complete. In the past 250 years of research, taxonomists have named about 1. 78 million species of animals, plants and micro-organisms, yet the total number of species is unknown and probably between 5 and 30 million. Taxonomists provide the basic vocabulary of biology if you like, defining each new species (individual words) and making sure there are accurate definitions of those species like a dictionary and records of those species, as DNA or actual specimens in museums so that everyone knows exactly which species is which and what other species it is related to. Without this kind of knowledge we cannot begin to do the simplest things with any degree of accuracy . For example, if you do not know what species any given organism belongs to, then it becomes very hard to say anything meaningful about it. If we think critically, how do we protect a given species if we don’t even know what is, and what is not, a member of which species? If given a scenario in our agriculture field if there is a new insect is eating your crops . Firstly, we have to know what is it, how

can we kill it and is there are there any possibilities that we might kill by mistake that are actually beneficial? Taxonomy is the subject that play an important role as a fundamental to our understanding of the natural world and critical to future research. We must know what species we have and what they are to be able to continue to study everything from infectious diseases to pollution and the history of life. If we are going to save our planet, we have to know what is on there to start with. From finding the specimens to the name appearing in print can take several years and many living organism have extinct before we able to identify them, thus we need more taxonomist with taxonomy knowledge in taxonomy field.

How do we know what is helping us achieve agricultural sustainability?

Taxonomists identify species in the wild, notice the risk of extinction or the arrival of invasive species and follow the changes in biodiversity over time. They undertake inventories to survey the flora and fauna of various areas and provide advice for their protection. They also serve as experts for customs services, human and agricultural health services or resource management expertise. Taxonomic information is essential for agencies and border authorities to detect, manage and control of Invasive Alien Species (IAS). Effective control and management measures can only be implemented when exotic species are correctly and promptly identified. Misidentifications can cost money when rapid decisions need to be taken. Networking and sharing of experiences, information and expertise can aid in lowering the costs associated with invasive alien species and reduce the need for eradication program with early detection and prevention. When eradication

is needed, taxonomists can offer expertise in developing the most effective yet economic and environmentally friendly eradication steps. Increased capacity-building especially for developing countries is necessary to identify, record and monitor invasions so that can provide current and accessible lists of potential and established IAS. Taxonomist also can perform an important role at identify potential threats of IAS to neighbouring countries and to access information on taxonomy, ecology, genetics and control methods. It is vital that host countries and all countries along a particular pathway for invasive species can recognize such species and correspond on their classification.

3.)Do we know what is enriching our soil?

Yes, we do know what is enriching our soil but we only know part of it. The soil microorganism diversity is vast, and it is estimated that more than 99% of species remain unidentified. Soil microorganisms are a very important element of healthy soil. Soil microorganisms are responsible for:

a.)Transforming raw elements from one chemical form to another. Important nutrients in the soil are released by microbial activity are Nitrogen, Phosphorus, Sulfur, Iron and others.

b.)Breaking down soil organic matter into a form useful to plants. This increases soil fertility by making nutrients available and raising CEC levels.

c.)Degradation of pesticides and other chemicals found in the soil.

d.)Suppression of pathogenic microorganisms that cause diseases. The pathogens themselves are part of this group, but are highly outnumbered by beneficial microbes.

There are several types of microorganisms in soil that benefit plants. Together they make up an immense population of living organisms. One teaspoon of soil may contain millions of various types.

a.)Bacteria – Small, single cell organisms that make up the single most abundant type of microbe. A gram of soil may contain 20, 000 different species. In soils, they multiply rapidly under the proper conditions. When conditions are wrong for one species, it is right for another. Due to their diversity they play many roles in the soil and are involved in all of the organic transactions. Their most important role is in decomposition of dead organic matter and mineralization of nutrients such as N and S to forms available to plants. Another critical process in which bacteria are prominent is N-fixation.

b.)Fungi – The largest microbe group in terms of mass. Some fungi are beneficial that form a symbiotic relationship with plant roots, either

externally or internally. Within the fungi group are pathogen fungi. These are disease causing fungi, some of which can be quite devastating to plants.

c.)Protozoa – Small single cell microbes that feed on bacteria. Protozoa belong to soil microfauna. All protozoans are heterotrophic, and usually obtain their food through some form of ingestion followed by intracellular digestion. Some species actively prey on live bacteria, whose population they control. They are commonly found near roots and other places where bacteria congregate. Typically when bacterial populations increase then the protozoan populations also increase. Because protozoa have lower N requirements than many bacteria, they excrete excess N obtained from the consumption of bacteria as ammonia (inorganic N). Hence protozoa are important in enhancing mineralization in soil by releasing the N taken up by bacteria.

d.)Actinomycetes – Necessary for the breakdown of certain components in organic matter. They are single-celled, prokaryotic, filamentous and often profoundly branched organisms. They are of great importance in the decomposition of soil organic matter and the mineralization of nutrients, especially in alkaline soils. Many actinomycetes produce antibiotic compounds that kill other microorganisms

e.)Algae – Beneficial groups such as blue-green algae, yellow-green algae and diatoms. Some of these can produce their own energy through photosynthesis. Soil microorganisms are living, breathing organisms and, therefore, need to eat. They compete with plants for nutrients including Nitrogen, Phosphorus, Potassium and micronutrients as well. They also

consume amino acids, vitamins, and other soil compounds. Their nutrients are primarily derived from the organic matter they feed upon. The benefit is that they also give back or perform other functions that benefit higher plant life.

3.)What kind of research is required to support good taxonomy and can UTAR provide this services and how?

Firstly, the research that required to support good taxonomy should be on how to increase the number of taxonomist with expertise. Thus, we must start to remove or reduce this taxonomic barrier or in other words, the knowledge gaps in our taxonomic system, the shortage of trained taxonomists and curators, and the impact these deficiencies have on our ability to conserve, use and share the benefits of our biological diversity.. The level of expertise that taxonomists can bring to bear requires strong training. Education in hands-on practical knowledge as well as theory and methodology is the one of the way to increase the number of expert taxonomist. Each country and region, in addressing this wide range of biodiversity issues, has different needs and priorities regarding taxonomic support and there are the same problem faced in Malaysia too. There are millions of species still unidentified in biodiversity rich country like Malaysia but unfortunately there are far too few taxonomists to do the job. In the past, taxonomist from the industrialized country came to the developed but rich in biodiversity country like Malaysia to collect the specimen and in the end the copyright of the newly identified species belong to the industrialized country although it actually native from Malaysia. After learning from the past history, we must build up, train and produce more taxonomist in Malaysia .

UTAR of course can provide this service to increase the number of taxonomist in Malaysia. With the catalyst of education especially in institution of high education, we can solve the lack of taxonomic information and expertise available in many parts of the world, and thereby to improve decision-making in conservation, sustainable use and equitable sharing of the benefits derived from genetic resources. But, at first UTAR need to provide several tools to help train the next generation of taxonomists. UTAR must developed a simple to use identification guides for the under graduate or even the non-taxonomist farmers that work on the field. Besides, UTAR must translate and modified the taxonomic information in formats and languages that are suitable or accessible in our country this is because many specimens from developing countries are often studied in industrialized nations and the taxonomic information are always wrote in English.

Besides that, the teaching syllabus of taxonomy in UTAR must not only the in classroom but must also allow their student to go into the field and identified the species themselves so that they can gain experiences.

What areas of modern sciences can promote taxonomy in our country?

Modern sciences such as biotechnology can promote taxonomy in our country. Identification of large, charismatic animals may be easy. However, the majority of organisms are insects, plants, fungi and microorganisms, which require expert skills for correct identification. Most of them have not been categorized or given formal scientific names. The inability to identify or obtain identifications of species is a major component of the taxonomic barrier. Modern sciences such as biotechnology can help in solving this

barrier. Engineer should corporate with biologist in inventing a new technology which can provide convenience for the taxonomist to identify the new species with a shorter time, lower cost and effectively. For example there should be a devices that are connected with the database of all identified living organism species . Thus, when we use the devices to scan on the living organism that we discover then we will initially identified whether it’s a new species based on the external character . Besides, with the help of biotechnology it can help in lower the level of requirement to become a taxonomist thus can increases the number of taxonomist in Malaysia. Maybe in the future even a farmer with the basic knowledge and the skill to handle the devices can be a taxonomist.

Summary

In conclusion, taxonomy is the science of naming, describing and classifying organisms and includes all plants, animals and microorganisms of the world . Taxonomic knowledge is a key input in the management of all types of ecosystems, from marine areas to forests to drylands. We need taxonomy because there are many more species that remain unidentified in Malaysia thus we need to use taxonomy to catch up the pace that we have lose far behind. Taxonomy is consider as a sciences because it involve the discipline of scientific method which are observation, hypothesis, research and experimentation and conclusion and it also it also the required critical and logical thinking that sciences need. We need taxonomy because it help us in effectively addressing alien species insects and thus leads to sustainable agriculture. In promoting good taxonomy, understanding the taxonomist needs and priorities is the important first step to overcoming the taxonomic

impediment barrier. The barrier is the knowledge gap and the lack of taxonomist is the main problem thus we need education to overcome this problem. The area of modern sciences that can promote taxonomy in Malaysia is throught biotechnology. Through biotechnology, new gadget or devices invented which is more portable and easy to use will help in identified a living organism more easily. will help in Collection institutions in industrialized countries also hold most specimens from these developing countries, as well as associated taxonomic information. Furthermore, although there is extensive taxonomic work on groups such as birds, mammals and higher plants, little is known of their distribution, biology, and genetics.