

Panchtatva, Agriculture, and Sustainability of Life on Earth

Rajendra Prasad

(Ex-ICAR National Professor, Indian Agricultural Research Institute, New Delhi 110012, India),
6695 Meghan Rose Way, East Amherst, NY 14051, USA (email: rajuma36@gmail.com)

Abstract

According to ancient Indian scriptures including the recent Ramcharitmanas, five elements of nature, namely, earth, water, fire, sky, and wind are responsible for the creation, survival, and sustainability of human life on earth. The earth's gravitational force keeps all non-living and living objects stable and on ground. Earth provides land for agriculture and nutrients for plants that provide food for humans and animals. Earth provides the place for dwellings and is a store house of coal and fossil fuels that provide energy for locomotion and industry. Water is essential for life and water ways have been used for navigation since times immemorial. Hydel power also provides electricity. Fire is well known purifier even now and helps in cooking raw food. Energy is required for all mechanical and biological processes. Solar energy is essential for photosynthesis. Solar power is now being used for generating electricity, lightening homes, and for driving cars. Wind has oxygen, without which humans and many animal species cannot survive. Wind also has carbon dioxide the source of carbon in photosynthesis, the process responsible for manufacture of food by plants and the very basis of agriculture. Wind also has nitrogen, the source of protein for humans, and other living beings. Trade winds were responsible for the movement of people and goods in pre-motor-powered-ship era. Wind power is now being utilized for generating electricity. Sun, moon, clouds, and nitrogen in the sky are important for life on earth. Thus the present advancements made in understanding and utilizing the five elements of nature, prove the vision of our ancient sages and their careful management is the only way for a sustainable living on the planet earth.

Great saints of India from the Vedic times have told that life is created and preserved by *Panchtatva* or *bhutas* (five elements) of nature, which Goswami Tulsidas has narrated in reference to human body in 'Ramcharitmanas' (Kishkindhakand, 11/2) as follows:

“Kshiti (earth), jal (water), pawak (fire),

gagan (sky), sameera (wind); Panch (five) tatva (elements or components) yeh (this) adham shareera (body)”.

This communication makes a humble effort to explain the role of these *Panchtatva* (five elements) in supporting life on the planet earth in the context of present day scientific knowledge.

Goswami Tulsidas has narrated in reference to human body in 'Ramcharitmanas' (Kishkindhakand,11/2) as follows: "Kshiti (earth), jal (water), pawak (fire), gagan (sky), sameera (wind);Panch (five) tatva (elements or components) yeh (this) adham shareera (body)".

Kshiti or Earth

The surface area of earth is 510 million km², of which 361 million km² (about 71% of total surface) is covered with water (USGS, 1984); fresh water is about 2.5% of the total water on the earth. This distinguishes earth from other planets and shows the importance of water in life. Human body contains about 55–75% water depending on age and health status (Guyton, 1991). Earth's surface crust, generally called 'Pedosphere' is oxygen dominant, because most minerals, such as, silicates (nearly 90%), oxides, hydroxides, carbonates, phosphates, sulphates etc. are all oxygen compounds. Bulk of surface layer is rich in silica (SiO₂) and silicates (SiO₄) of Al, Fe, Mg, Ca etc. and also has deposits of carbonates and bicarbonates (white and black alkali), and gypsum (CaSO₄). Most metal ores such as those of iron (magnetite, hematite, etc.) and aluminium (bauxite) are oxides or hydroxides. As a matter of fact when the lava cooled and the earth was formed some million years back, most metallic cations (Si, Al, Fe, Mn, Mg, Ca, Na etc.) just fitted

in the void between oxygen atoms forming different crystal structures (Shultze, 1989). The radius of an oxygen atom can vary from 126–140pm (picometers) as compared to the ionic radii of 40 and 67 pm for Si and Al, respectively (Rao, 1999). Eight elements present in the largest amount (on weight basis) are oxygen (46.6%), silicon (27.7%), aluminium (8.1%), iron (5.0%), calcium (3.6%), sodium (2.8%), potassium (2.6%), and magnesium (2.1%) (Marshall and Fairbridge, 1999).

Earth contributes to human life in many ways, some of which are:

- Earth's gravitational force and magnetic fields keep all objects stable and on ground.
- Earth provides land for agriculture, which provides food for all humans and animals.
- Supplies nutrients for plants, trees and grasses (Prasad *et al.*, 2014), which permits agriculture, the art and science of growing of green vegetables, grains, and fruits for humans, and forage for animals.
- Place for dwelling. As the man turned from hunter–gatherer to a settler in villages, place and construction materials for erecting dwellings was provided by the earth. Land availability today is a serious problem in big cities, where land cost may vary from a few hundreds to a few lakhs of Rupees per square foot.

- Stores water that comes from rains on surface as ponds, lakes, and rivers or underground as aquifers. Underground water is the major source of drinking water and irrigation water globally. The amount of precipitation falling on land is estimated at 110000 km³ per annum, out of which 56% is evapotranspired by forests and natural landscapes and 5% by rainfed agriculture. The remaining 39% or 43000 km³ of water is converted to run-off (feeding rivers and lakes) and groundwater and is referred to as renewable fresh water reserve (RFWR). Out of the total RFWR, about 69% is used for agriculture, 12% for municipal use, and 19% by the industry globally; the values for South and Southeast Asia are 91% for agriculture, 7% for municipal use and 2% for the industrial use (FAO, 2015).
- Earth is a treasure house of fossil fuel or black gold (Wright and Gallun, 2008), natural gas, coal and most metals and minerals. Most of the ground, water and air transportation (including transport of farm and orchard produce) depends on earth's fossil fuel (petrol, diesel, natural gas, and coal). In addition, these materials also play a major role in the generation of electricity. In India, the contribution of coal, natural gas and diesel in the

generation of electricity in 2015 was about 60.6%, 8.5%, and 0.4%, respectively (CEA, 2015).

- Provides refuge for human and animal waste. Seepage tanks and landfills are used all over the world.

No wonder all the wars in the past and present in the world have been and will continue to be fought for the land. In the Indian context, some of the great wars for land include Mahabharata (3139 BC as per Vedic Foundation, via internet), conquest of Nanda empire by Mauryas (321–320 BC), battles of Panipat (1528, 1558 AD), siege of Delhi by the British (1804) and battles of Agra, Kanpur, and Lucknow known as "Indian mutiny" (1857) (Wikipedia, via internet).

Jal or Water

As the saying goes "*Jal hi Jeewan hai*" (water is life). All the physiological and biochemical processes of animal and plant life take place in an aqueous medium. About 55–75% of human body is water. This also applies to most of the green plant tissue.

While the *Rigveda* (RV) highlights Vedic views on the origin of water, its sacrificial and practical importance in addition to its recognition for the deeds beyond human capacity, the *Atharvaveda* (AV), although arguably less contributive to the classical interpretation of the Vedas and 'the religion' formed out of them, vividly depicts the therapeutic plus emancipative strength of water, aqua-related spirits and their

Earth provides land for agriculture, which provides food for all humans and animals.

influence on humans. Moreover, in the *Brāhmaṇa* and early Upanishadic literature, a number of Brahmanic perspectives on water unveiling diverse aspects of Vedic religion can be traced (Rohana Seneviratne, 2012). A hymn for water is given below:

*yāpodivyaūtavāsravantikhanitrimāutavā
yāhvayañjah/*

*Samudrārthāyāḥśucayaḥpāvākāstāpode
vīrihamāmavantu//*

(Waters which come from heaven or those that wander dug from the earth, or flowing free by nature, bright, purifying, speeding to the Ocean; here those Waters, Goddesses, protect me.)

One of the major roles of water related to human life discovered by modern science is the production of oxygen from the photolysis of water (Pushkar *et al.*, 2008) in photosynthesis in plants (Campbell *et al.*, 2006).

Water bodies on the planet earth contribute to life on earth in several ways.

- River, lake, and ground water provide drinking water to humans and animals and irrigation water for agriculture.
- Water bodies (oceans and seas) produce clouds, which causes rain, the major source of surface (lakes, ponds, rivers) and ground water. Absence of rain for a prolonged period results in the development of deserts, while failure of rains leads to droughts and famines.

- This is very much applicable to India. In the 18th and 19th centuries, droughts and famines occurred frequently in India. In the famine of 1876–78, about 60 million people were affected and mortality exceeded 5.25 million, while the famine of 1899–1900 affected 55 million people and resulted in a serious loss of human lives, crops, and cattle. Appointment of Famine Commission in 1880, Irrigation Commission in 1901, establishment of provincial departments of agriculture and the Imperial (now Indian) Agricultural Research Institute (IARI) at Pusa (Bihar) in 1905, which was shifted to New Delhi in 1935 are important milestones of Indian Agri–History (Randhawa, 1982) in its effort to overcome droughts and consequent famine. These efforts continue even today, as evident by the formation of the project on joining the Indian rivers (Misra *et al.*, 2007). Droughts occur even today in India (Maharashtra) (ToI, 2015).

- Asia is going to be affected by water

***A hymn for water is given:
(Waters which come from heaven
or those that wander dug from the
earth, or flowing free by nature,
bright, purifying, speeding to the
Ocean; here those Waters,
Goddesses, protect me.***

shortage mostly, because rice is the major crop, which is a heavy consumer of water; on an average about 1000–2000 mm/ha/season. Rice consumes about 50% of total irrigation water used in Asia (Barker *et al.*, 1998). Rice growers in Asia are using too much water and creating problem for the future generations. For example, in North China Plain (NCP), water table is declining by 1–3 m each year (Shah, 2005), while in the Indo–Gangetic Plain (IGP) of India it is declining by 0.5–0.7m each year (Tuong and Bauman, 2003). In the Punjab state of India the water pumped out to irrigate rice, when expressed as percentage of recharge was 169–350 (Prasad, 2011). Water in agriculture has therefore to be more efficiently used. This point was made by ancient writers in India long back in Kashyapiyakrishisukti written in ca 800AD (Nene, 2009).

- Water bodies contribute largely towards human food, which is generally referred to as sea food and includes fish, crustaceans, and mollusks and the estimates for 2005 were at 141.4 million metric tons.
- Navigation on water surfaces is as old as on land and mention of sea boats is made in *Yajurveda* (10.19) “Our royal skilled engineers, construct sea–boats, propelled on water by our experts, and airplanes, moving and flying upward, after the clouds that reside in the

mid–region, that fly as the boats move on the sea, that fly high over and below the watery clouds. Be thou, thereby, prosperous in this world created by the Omnipresent God, and flier in both air and lightening”.

The *Rigveda* mentions the following modes of transportation on water:

Jalayan – a vehicle designed to operate in air and water (*Rigveda* 6.58.3)

Kaara – a vehicle that operates on ground and in water (*Rigveda* 9.14.1)

A lot of trade in early days was carried out through sea routes.

- Hydel power (energy created by the fall of water) has been used for grinding of grains and other materials since ages. Even today there are 30 to 40 thousand grain grinding mills (locally known as *gharats* or *pan–chakki*) in Uttarakhand state of India (Saini and Kumar, 2006). Hydel power is now largely used for generating electricity at dams; in India it contributes 15.2% to the total electricity produced in the country.
- Water surfaces also provide refuge for human waste. Most urban sewage from Indian cities is dumped into rivers, polluting their water. Pollution of the waters of Ganges and other rivers due to city refuse and sewage has been well talked about and written in India (Sampat, 1996; Hamner *et al.*, 2006; Das and Tamminga, 2012).

Water in agriculture has therefore to be more efficiently used. This point was made by ancient writers in India long back in Kashyapiyagrishisukti written in c.800AD.

Pawak or Fire/Energy

Although Goswami Tulsidas has used the word 'pawak' which literally means fire, in broader perspective it includes all kinds of energy including electricity produced by thermal (coal), hydel, solar or wind as the source. In Sabha Parva (Section VII) of Mahabharata, Narada muni speaks of 27 kinds of fire including *grahprtya* (the perpetual household fire), *nirmanthya* (fire produced by friction) and *vidyuta* (lightening, electricity).

Fire has been known to humans since ages as a purifier, and was used for performing most rituals (worships to gods, weddings, ceremonies after death (Vesci, 1985). In India even now these rituals are performed around a '*havankund*' (a sort of bone fire).

All Vedic rituals involve *Agni*. *Agni* (Fire) is the first word of the first hymn of the *Rigveda* (1.1.1):

*(agnīmīḷepuróhitam / yajñásyadevám
rtvijam / hótāraṃratnadhātāmam)*

[*Agni* I laud, the high priest, god, minister of sacrifice, the invoker, lavishes of wealth.]

According to *Rigveda* *Agni* is the supreme director of religious ceremonies and duties, and figures as messenger between mortals and gods; 218 out of 1,028 hymns of the *Rigveda* are dedicated to *Agni*.

Fire was used for frightening and keeping away the wild animals. Fire has also been used for clearing the forest for agriculture for a period of few years, as long as the soil remains fertile. This is practiced in several countries including India and is known as 'shifting cultivation' or *Jhumming* (Shirmah *et al.*, 2015).

Wood from the forest trees was the only source of energy known to ancient humans. Sources of energy, such as, electricity and fuel oil have been added only in recent times. Solar energy and its application in life are still in infancy. So is the wind as the source of energy. Role of solar energy in photosynthesis in production of food on planet earth is also the discovery of modern science. All food on earth for animals and humans is produced by green plants through photosynthesis in agriculture. Agriculture is the only way to produce food and that is why in ancient times it was considered the noblest profession in India. Energy is required for a number of processes essential for life, a few of which are listed below.

- Production, storage, transportation, and cooking of food
- Pumping of ground water, its transportation from point of production to the point of use, and its purification.

Although Goswami Tulsidas has used the word 'pawak' which literally means fire, in broader perspective it includes all kinds of energy including electricity produced by thermal (coal), hydel, solar or wind as the source.

- Construction of homes, their lightning etc.
- Medical treatment and maintaining of hospitals.
- Running of industries.
- Destruction of waste including dead animal and human bodies.
- Transport on ground and water surfaces and in air.

Electricity has been a major source of energy in human life and is used in many of the processes listed above. Lightning of homes, towns and cities, heating of homes and other buildings in cooler regions and cooling them in warmer regions of the world would not have been possible without the electricity. All industries need electricity. In agriculture, refrigeration, and cold storage help preserve food and save it from spoilage.

Gagan or Sky

This is most difficult to interpret and understand. However, when one looks up in the sky, other than the empty space, there

Agriculture is the only way to produce food and that is why in ancient times it was considered the noblest profession in India.

are three visible objects, namely, sun, moon, and clouds.

Sun. We know very well from the existing knowledge in botany and agriculture that all food for the entire animal and human life is produced by photosynthesis (Rutherford and Bussac, 2004; Campbell *et al.*, 2006; Yamori, 2013) for which carbon di-oxide, water, and solar radiation are the three primary requirements. Thus solar radiation is of utmost importance to agriculture. Solar radiation also gives us day light and heat, which are necessary for our survival and safety.

The Aditya–Hridayam Hymn, a part of the Yuddha Kanda (the chapter of war) of Valmiki Ramayana is in praise of Sun and contains 31 *shlokas*. Sage Agasthya Muni gave this powerful mantra to Sri Rama to propitiate Lord Sun to obtain blessings, strength, and power to defeat Ravana. It begins with:

*Nama Suryaya Santaya Sarvaroga
Nivarine / Ayurarogyamais vairyamdehide
vahjagatpate //*

(Oh! Lord Surya, ruler of the universe, you are the remover of all diseases, the repository of peace; I bow to you. May you bless your devotees with longevity, health, and wealth).

In the seventh *shloka* (given below) it mentions about the power of sun's rays to produce food.

sarvadevatmakohyeshatejasvirashmi–bhavanah/

*eshadevasuraganan
lokanpatigabhastibhih //*

(Indeed, He is the very embodiment of all Gods. He is self-luminous and sustains all with his rays. He nourishes and energizes the inhabitants of all the worlds as well as the host of Gods and demons by his Rays).

Sun is also glorified in *Rigveda* (10.170.4) as given below:

*Beaming forth splendor with thy light,
Thou has attained Heaven's lustrous realm,
By thee were brought together all existing things,
Possessor of all Godhead, All affecting God.*

Due to the climate warming effects of coal and fossil fuels in generating electricity, man has now turned to solar power for generating electricity. Countries like India must go all the way for utilization of solar power, which is available in plenty. Fortunately, Government of India has already initiated necessary action in this direction and there are plans to produce 100 GW of electricity using solar power in the near future (India Abroad, 2015). It may be added that Cochin in India is the first completely solar powered airport in the world. It has 46,000 solar panels and

Oh! Lord Surya, ruler of the universe, you are the remover of all diseases, the repository of peace; I bow to you. May you bless your devotees with longevity, health, and wealth.

produces enough electricity to meet the annual needs of 10,000 homes. Further, it reduces CO₂ emissions by more than 300,000 metric tons, which is equivalent to planting 3 million trees or not driving 750 miles (Menon, 2015).

Moon. Moon, which reflects the solar radiation, is of no less importance. In the early days of human evolution moon was the only source of light in the night that permitted movement and safety from the wild animals, before the lamp was discovered. As the hamlets developed, full moon night was used for religious or other gatherings of the village folk. Full moon night is considered the best for reciting Satya Narayana *katha* (a religious story in praise of Lord Satya Narayana). There are a number of festivals all over India, which are celebrated on full moon nights including *Holika dahan (Holi)* in *Phalgun* month (March–April), *Guru Purnima* in *Ashadh* month (May–June), *Raksha bandhan* in *Shravan* month (July–August), and *Kartik Purnima* in *Kartik* month (November–December). In Hindu calendar all months are of 30 days, 15 days each for bright and dark fortnight of moon, and therefore the dates of festivals vary from year to year of the modern Christian

era calendar. In Hindu mythology moon is considered the God of plants and vegetation (Wilhelm, 2006). Moon has been the symbol of beauty in poetry and finds a mention in many lullabies in India (Warda, 1989).

Clouds. The sky also houses clouds, which are the only source of fresh water, the elixir of life, on the surface of earth. A lot has therefore been written in praise of God Indra (who controls clouds and rains) in ancient scriptures. In Indian mythology clouds are equated with divine cattle and sounds of thunder during storms as Indra fighting with the demons who are ever trying to steal the celestial cows, and the rain is equated with Indra milking his divine herd (Ancient History Encyclopedia, UK). For example, in *Rigveda* (10.23.4) it is said “With him too is this rain of his that comes in herds”. On the literary side is the famous Sanskrit poem 'Meghadoot' (cloud messenger) by the great poet Kalidas.

Agriculture and food production depends on rains and the production is good, when rains are well distributed. Less rains leads to drought and heavy rains lead to floods. Without clouds, rains are not possible and there will be no agriculture and no life

Ozone layer. Modern science has added to our knowledge the presence of Ozone layer (about 30–40 km above sea level) in the stratosphere of the earth's atmosphere. The major role of Ozone layer is to prevent/reduce the ultra violet radiation from the Sun reaching the earth surface.

Exposure to ultra violet radiation can lead to skin cancer and other ailments in humans (Narayanan *et al.*, 2010). In recent years there has been great concern about the increased production of nitrous oxide from the nitrogen fertilizer applied to agricultural fields (Pathak, 2013) resulting in the reduction of Ozone layer (Ravishankara *et al.*, 2009).

Sameera or Wind

Earth's atmosphere consists of a number of layers, namely, Troposphere (up to 14 km from earth's surface), Tropopause [14–18 km above earth's surface (aes)], Stratosphere (18–50 km aes) and Mesosphere & Ionosphere (50–350 km aes). From the viewpoint of life on earth, one is mainly concerned with Troposphere, which has nearly three-quarters of the atmosphere's total mass of 5×10^{18} kg. The winds which mostly affect human health and life generally blow in Troposphere, which contains the following gases: 78.08% nitrogen, 20.95% oxygen, 0.93% argon, 0.038% carbon-dioxide, 0.001% (neon, helium, krypton), and water vapor (0–4%), (depending on the closeness to the water bodies, such as, sea, river, lake etc.) (Egger, 2015). Of the various gases in the atmosphere oxygen, carbon dioxide, and nitrogen are important in human life.

Oxygen. Oxygen is essential for animal and human life. Since oxygen is produced on the surface of earth by photolysis of water in plants, its concentration is most at the earth's surface and declines with altitude; 5000m is the highest altitude at

which the barometric pressure of oxygen is 50% of that at sea level and human life can survive (Prasad, 2012).

Carbon dioxide (CO₂). It is a minor but very important component of the atmosphere. Probably in the beginning, when there were no plants, CO₂ originated from carbonates in the earth crust, however, most of it now comes as a part of respiration in the living being and oxidation/decomposition of organic tissue. Carbon dioxide along with water (from soil) and solar radiation is the triad that produces food for all living beings on earth through the process of photosynthesis in plants.

However, CO₂ has been recently at the receiving end and its increased level is considered as the main source for global warming. Carbon dioxide is released through natural processes such as respiration and volcano eruptions and through human activities such as deforestation, land use changes, and burning fossil fuels. Humans have increased atmospheric CO₂ concentration by a third since the Industrial Revolution began; it has increased from 21.6 billion tones in 1991 to 27.0 billion tones in 2005. The main human activity that emits CO₂ is the combustion of fossil fuels (coal, natural gas, and oil) for energy and transportation, although certain industrial processes and land–use changes also emit CO₂ (NRC, 2010).

Nitrogen. As already mentioned nitrogen makes up about 78% of the atmosphere.

Ninety-nine percent or even more of it is present as non–reactive nitrogen gas (N₂) and has a role of conservation of life, because it prevents destruction of living beings by oxidation. On the other hand active nitrogen, which is less than 1% in the atmosphere, is responsible for the production of proteins, the organic molecules that separate living from non–living organisms to a large extent. Plants, animals, and humans cannot use atmospheric nitrogen directly. Only a few groups of microorganisms can convert N₂ gas to amide group leading to the production of amino acids and proteins and the process is known as biological di–nitrogen or nitrogen fixation.

Nitrogen fixation is done by free living heterotrophs, such as, *Azotobacter*, *Clostridium* etc. (10–20 kg N/ha/y), and associative organisms, such as, *Azospirillum* (20–30 kg N/ha/y) and by symbiotic bacteria in *Azolla* and in leguminous plants (30–300 kg N/ha/y). Role of atmospheric N in food production has been realized since ages. Shifting cultivation is one example, where after clearing forests the land was cultivated for a few years until soil remained fertile (could supply adequate N) and was left fallow (uncultivated) for a few years for replenishment of soil in shifting cultivation (Garbyal, 1999). This practice is known as '*jhumming*' in India (Shirmah *et al.*, 2015).

Nitrogen in the atmosphere is responsible for creating different forms of life, because it is a constituent of DNA and RNA. Once the life is created, its growth also largely

depends upon proteins, which again are nitrogen compounds. Bodies of all animals including man (*Homo sapiens*) are made of proteins, N being the element differentiating them from carbohydrates and fats. Thus atmospheric N plays the role of *Brahma* (the Creator) as well as *Vishnu* (the preserver). Cryogenic preservation of living bodies using liquid nitrogen is practiced in most biological laboratories.

Industrial N fixation started with the development of Haber–Bosch process of ammonia synthesis in the early 20th century, which paved the way for fertilizer industry. Haber received Nobel Prize in 1918 for this discovery and Carl Bosch receive Nobel Prize in 1930 for substituting iron oxide as a catalyst in the ammonia synthesis in place of Osmium (a rare element) used by Haber, which made it possible at the industrial scale. But for the fertilizer nitrogen, the world would have starved, because biological N is a slow process and several times of the land would have been required for producing the desired amount of cereals and other food. About 50% of the protein required to meet human needs comes from industrially fixed fertilizer nitrogen (Prasad and Shivay, 2015).

Wind per se. Besides the roles of individual gases just discussed wind per se plays several important roles in human life. Vedas describe 49 different forms of winds including *Pravaha*, *Avaha*, *Udvaha* (water carrying), *Samvaha*, *Vivaha*, and *Parvaha*. *Paravaha*. ([http:// www.globalhinduism.com/2012/12/29/vedas-describe-49-different-forms-of-winds-in-nature-](http://www.globalhinduism.com/2012/12/29/vedas-describe-49-different-forms-of-winds-in-nature-)

[hinduism/#Xu_GJ3zK8U0DWbzfzfc.99](http://www.globalhinduism.com/2012/12/29/vedas-describe-49-different-forms-of-winds-in-nature-hinduism/#Xu_GJ3zK8U0DWbzfzfc.99)). Two part–hymns translated from *Rigveda* (Griffith pdf, 2005) are:

O, The Wind's Chariot, O its power and glory,

Crashing it goes and hath a voice of thunder;

It makes the regions red and touches Heaven.

And as it moves the dust of earth is scattered. (Rigveda 10.168.1)

Travelling on the paths of air's mid region, No single day doth he takes rest or slumber, Holy and the earliest born, friend of the waters,

Where did He spring and from what region came He? (Rigveda 10.168.3)

Wind helps in maintaining life on earth in several ways. Some of these are:

- Wind has a major role in carrying clouds formed at the water surface to different regions of the earth, where they cause rain. Monsoon rain in India is caused by south–westerly winds. Some rain in the south and east India comes from north–easterly winds.
- Winds known as 'trade winds' have played a major role in international trade before the arrival of modern power driven ships. The use of wind to provide mechanical power came somewhat later in antiquity.
- *Rigveda* also mentions *Vaayu Ratha*, a gas or wind–powered chariot. (*Rigveda*

5.41.6) and *Trichakra Ratha*— a three-wheeled vehicle designed to operate in the air. (*Rigveda* 4.36.1)

- As regards modern era, US inventor Charles F Brush produced electricity using a wind powered generator in the winter of 1887–88 and it powered his home and laboratory until about 1900 (Wikipedia via internet). Wind power is being currently used for generating electricity in several countries; China, with a production of 114763 MW tops the list, while India with a production of 23780 MW is at the fourth place. Government of India has plans to produce 80GW of electricity using solar power in the near future (India Abroad, 2015).

Conclusion

The fact that five elements of nature (earth, water, fire/energy, sky, and wind) are responsible for the preservation of life as told in *Vedas*, *Puranas*, and *Ramcharit manas*, is now being proved by modern scientific studies. For example, studies in agriculture have proved that the earth supplies all the essential plant nutrients and water for the plants. Similarly, it is established that solar energy, carbon dioxide from the air (wind), and water from

the soil are three basic ingredients needed for photosynthesis in plants, which is responsible for the growth of plants that directly or indirectly provide food for the humans and animals on the earth. Water and oxygen are essential for plants, animals, and humans. Overuse of coal and fossil fuels for generating electricity and driving vehicles has led to global warming and scientists and governments all over the world are turning to hydel (water), wind, and solar power for generating electricity and driving vehicles. It is concluded that for sustainable living on the planet earth more and more reliance has to be placed on the efficient use of *Panchtatvas* (five elements) of nature, namely, *kshiti* (earth), *jal* (water), *pawak* (fire/energy), *gagan* (sky), and *sameera* (wind) as told by old Indian saints and sages.

References

- Barker R, Dawe D, Tuong TP, Bhuiyan SI, and Guerra LC.** 1998. The outlook for water resources in the year 2020: Challenges for research on water management in rice production. In “Assessment and Orientation Towards the 21st Century”. 7–9 September 1998. Proceedings of 19th Session of the International Rice Commission, Cairo, Egypt, FAO. pp. 96–109.
- CEA.** 2015. Growth of electricity centre in India from 1947–2015. Central Electricity Authority, Ministry of Power, Government of India, New Delhi.
- Campbell NA, Williamson B, and Hayden RJ.** 2006. Biology Exploring Life. Boston, USA, Pearson Prentice–Hall.
- Das P and Tamminga K.** 2012. The Ganges

Vedas describe 49 different forms of winds including Pravaha, Avaha, Udvaha (water carrying), Samvaha, Vivaha, and Parvaha.

and the GAP: an assessment of efforts to clean a sacred river. *Sustainability* 8(4):1647–1668.

Egger AE. 2015. The composition of earth's atmosphere. Visionlearning Inc., National Science Foundation and the US Department of Education, USA (via internet).

FAO. 2015. AQUASTAT, Food and Agricultural Organization of the United Nations, Rome (aquastat@fao.org).

Garbyal SS. 1999. *Jhuming* (shifting cultivation) in Mizoram (India) and new land policy—how far has succeeded in containing the primitive agricultural practice. *Indian Forester* 125(2):137–148.

Griffith RTH. 2005. Based on 'The Hymns of Rig Veda' translated with proper commentary by Ralph T H Griffith and edited by Prof J L Shastri, Motilal Banarsidass Publishers, New Delhi, new revised edition 1973, reprint 2004 and 'Hymns of Rig Veda' translated into English with a popular commentary. Munshiram Manoharlal Publishers, New Delhi, reprint 1999.

Guyton AC. 1991. Textbook of Medical Physiology, 8th Ed, Philadelphia, USA, WB Saunders.

Hamner S, Tripathi A, Mishra RK, Bouskill N, Broadway SC, Pyle BH, and Ford TE. 2006. The role of water use patterns and sewage pollution in incidence of water-borne/enteric diseases along the Ganga river in Varanasi, India. *International Journal of Environment and Health Research* 16(2):113–132.

India Abroad. 2015. Renewable energy, made in India. India Abroad, New York, 2nd October 2015, pp. A17.

Marshall CP and Fairbridge RW (Eds.) 1999. *Encyclopedia of Geochemistry*, Dordrecht, Netherlands, Kluwer.

Menon Supriya. 2015. How is the world's first solar powered airport fairing. BBC News, Features & Analysis, 8th October, 2015.

Misra AK, Saxena A, Yaduvanshi H, Mishra A, Bhadauria Y, and Thakur A. 2007. Proposed river-linking project of India: A boon or bane to nature. *Environmental Geology* 51(8):1361–1376.

NRC. 2010. *Advancing the Science of Climate Change*. National Research Council, National Academic Press, Washington, DC, USA.

Narayanan DL, Saladi RN, and Fox JL. 2010. Ultraviolet radiation and skin cancer. *International Journal of Dermatology* 40(9):978–986.

Nene YL. 2009. Indigenous knowledge in conservation agriculture. *Asian Agri-History* 13(4):321–326.

Pathak H. 2013. Nitrogen and climate change: Interactions, impacts, mitigation and adaptation. *Journal of Indian Society of Soil Science* 60:109–119.

Prasad R. 2011. Aerobic rice systems. *Advances in Agronomy* 111:207–255.

Prasad R. 2012. The planet earth, life, and agriculture—science, mythology, and history. *Asian Agri-History* 16(2):111–122.

Prasad R and Shivay YS. 2015. Fertilizer nitrogen for life, agriculture and the environment. *Indian Journal of Fertilizers* 11(8):47–53.

Prasad R, Kumar D, Rana DS, Shivay YS, and Tewatia RK. 2014. *Textbook of Plant Nutrient Management*, Indian Society of Agronomy, New Delhi.

Pushkar Y, Yano J, Sauer K, Boussac A, and Yachandra VK. 2008. Structural changes in Mn_4Ca cluster and the mechanism of

photosynthetic water splitting. Proc National Academy of Science, USA 105(6):1879–1884.

Randhawa MS. 1982. A History of Agriculture in India. Vol III. Indian Council of Agricultural Research, India, New Delhi. 422pp.

Rao CNR. 1999. Understanding Chemistry, University Press, Hyderabad.

Rutherford AW and Bousac A. 2004. Water photolysis in biology. Science 303: 1282–1284.

Ravishankara AR, Daniel JS, and Portman RW. 2009. Nitrous oxide (N₂O): the dominant ozone–depleting substance emitted in the 21st century. Science 326:123–125.

Rohana Seneviratne. 2012. Divine, Panacean and Emancipative Water in Vedic Religion. Paper read at 37th Spalding Symposium on Indian Religions, 23–25 March, 2012. Merton College, University of Oxford, UK. (<http://users.ox.ac.uk/~pemb3753/media/divine.water.pdf>).

Saini RP and Kumar A. 2006. Development of standard water mills in Uttarakhand. Himalyan Small Hydropower Summit, October 12–13, 2006, Dehradun, India.

Sampat P. 1996. The river Ganges' long decline. World Watch 9(4):1–8.

Schultze DG. 1989. An introduction to mineralogy In: Minerals in Soil Environment (Dixon JB, Weeds SB, eds.), Soil Science Society of America, Madison, WI, USA, Book Series 1:1–37.

Shah T. 2005. Groundwater and human development: Challenges and opportunities in livelihoods and environment. Water Science Technology 51(8): 27–37.

Shirmah T, Rao KS, and Saxena KG. 2015. The shifting agricultural system (Jhum) and strategies for sustainable agroecosystems in northeast India. Agroecology & Sustainable Food Systems 39:1154–1171.

ToI. 2015. Drought hits 90 lakh famers in Maharashtra. Times of India February 3, 2015.

Tuong TP and Bouman BAM. 2003. Rice production in water–scarce environments. In: Water Productivity in Agriculture: Limits and Opportunities for Improvements” (Kijne JW, Barker R, and Molden, eds.), pp. 53–67. CABI Publishing, UK.

USGS. 1984. The hydrologic cycle, US Geological Survey Pamphlet (USGS Water Science School, via internet).

Vesci UM. 1985. Heat and Sacrifice in the Vedas. Moti Lal Banarsidass Publishers, New Delhi.

Warda AK. 1989. Indian Kavya Literature. South Asia Books, New Delhi.

Wilhelm E. 2006. Graha Sutras. San Diego, USA, Kala Occult Publishers.

Wright CJ and Gallun RA. 2008. Fundamentals of Oil and Gas Accounting, 5th Ed, Penn Well Books, Tulsa. OK, USA.

Yamori W. 2013. Improving photosynthesis to increase food and fuel production by biotechnological strategies in crops. Journal of Plant Biochemistry and Physiology 1:113 (doi 10.4172/2329–9029.1000.113).