Review Article

To check the socio-economic importance of honey bee for developing countries in current financial crisis

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Abstract

This review is done for elaborating social and economic importance of honey bees. Honey bees are imperative natural source of many products including Honey, wax, and Royal jelly. Beside this their role in ecosystem is very astonishing including pollination service that is very obligate for our food production as well as earning from agriculture sector. Beekeepers manage the honey bees either for bee products or for pollination but principally their main endeavor is earning. Apiculture can generate enormous revenue for developing countries especially for rural population in present financial crisis. For this reason, good beekeeping practice, skill and bee disease management is required for better production. Women can also run this business as a helping hand with men. If we emphasis on this ecofriendly culture, we not only conserve honey bees and stable ecosystem, but we can increase profit as well.

Keywords: Beekeeping or Apiculture; Bees Declining; Earning Source; Honey Bee; Income source; Pollination

Introduction

Importance of Honey bee

Honey bees (*Apis mellifera*) are cosmopolitan specie and belong to order Hymenoptera. Approximately 26 sub-species of honey bees are found. These are social insects that live in colonies and about 60,000 individuals present in each bee colony. Each colony contains a single queen that lay eggs, 10,000 of female workers who work for the endurance and wellbeing of colony and drones who fertile the virgin females [1]. Bees species are native to Asia, Europe, Africa and also found in deserts, mountains,

savanna and grasslands etc [2]. Honey bees has high adaptation capacity and successfully acclimatize to different World's region [3]. Bees services largely depend upon the species richness and abundance [4]. Our society receives thousands of benefits from honey bee products. And, we get countless additional ecological benefits from these tiny creatures [5].

Honey, Propolis, Bee wax and Royal jelly

Honey bees are the greater chemist and engineers that manufacture valuable products (such as natural honey, bee wax, propolis, royal jelly etc) for this reason they are

managed globally. Honey, wax, propolis and some other bee products are used as food and in treatment of many diseases [6-8]. In past, honey was a natural sweetener throughout the world at the place of sugar later, the refinement method of sugar is developed but we cannot challenge its importance still now [9]. It also has strong religious background Holy Qur'an that is the Holy book of Islam has Surah al-Nahl whose meaning is Chapter of Honey bee which shows the importance of honey as food and medicines. Even Prophet Muhammad (PBUH) emphasizes the importance of honey for restorative and curing purpose in a Hadith [7, 10]. Honey is formed by nectar, pollen and honeydew that are collected by worker bees from different flowers [11-13]. Honey has complex composition. The quality of honey varies due to different sources of raw materials and storage conditions. Natural honey act as a nutraceutical agent both ancient and modern time because it has such composition which is associated with antioxidant, antimicrobial, anti-inflammatory, antiseptic, anticancer, and wound repairing properties [10, 12-17]. Honey consider as a second currency in Soviet bloc countries. Therefore, large numbers of people of this country are bee keepers [18]. Global honey production in 2007 is about 1.07 million metric tons that is 58% increase since 1961 [9] *Apis mellifera* collect resins from different plants and use it as a propolis. It is very important bee product that used for treatment of different human diseases due to antimicrobial activities including treatment of HIV-1 virus [19]. Bee wax is very important product which is used for making different products. Similarly, royal jelly has its own significance [9]. It has anti-inflammatory, anti-tumor, anti-fatigue, anti-leishmanial, moisturizing, emulsifying and many other properties due to which it is used for the treatment of many human diseases including some parasitic diseases and used in cosmetics for beauty purpose [7,

20, 21]. Honey bee larvae serves as a source of protein [10].

Bee venom therapy

Bee venom has 18 pharmacologically active components. It is used in a venom immunotherapy for the treatment of arthritis, back pain, sciatica, multiple sclerosis etc but its effectiveness depends upon the venom dose, exposure time to venom and the type of venom. But some time bee venom immunotherapy will fail due to some venom complications or some other reasons [8, 22].

Pollination

There is a great demand of honey bees for pollination service [23] without pollination there will be no more plants and crops on earth. Pollination is very important regulating, supporting and cultural ecosystem service [24, 25] for conservation of plants, animal's biodiversity and crop productivity [26, 27]. Almost 90% flowering plants including many crops depend upon animal pollinators for pollination [28] and bees pollination service is about >66% out of 15, 00 crop species [29]. Honey bees are principle species that plays an important ecosystem service as crop pollinators and world widely they remain as economically valuable pollinators [6, 30-34]. According to an estimation honey bee provide pollination services for up to 90-130 crops [35]. Honey bees are cheap, versatile, and easily available as compared to other pollinators [30]. Globally 65% food is produced independently by animal pollination and 15% to 30% or approximately 35% human food is produced by these pollinators without them our food might be in a grave jeopardy [6, 18, 32]. In a previous study it is concluded that in a single visit honey bee pollination produced three seeds [6]. But currently, global pollination service is declining [6, 18, 28] recently a study [36] showed that by loss of natural habitat and use of excessive pesticides minimized the visit of bees to that area resulting into excessive declining of

pollination. Same decline was observed in Europe and in USA [33, 37] known as “pollination crisis” [38] which is a great threat to the agriculture sector. Therefore, there is a huge recent interest of scientists, politicians, media and public towards pollinators. There is guarantee of pollination if only bees are in large number [31, 33, 39]. So, we can manage the pollination service by inputting of honey bee as pollinator with wild pollinators [28]. Although, humans will not decline with the extinction of honey bees but still world widely they are important pollinators for human food security [18, 40] so, in future there is enormous need of these pollinators due to rising stipulate of food for mankind [37, 41]. Honey bees are very accommodating for native crop pollination e.g. water melon that require huge pollination prerequisite [29]. In some countries pollination service is provided at rent at prescribe rates to farmers especially for crops such as Almond, Sunflower, Canola (seeds), Grapes, Apples, Sweet cherries, Watermelons, Avocados etc. [35].

Beekeeping or apiculture

Apiculture is the management of bee colonies by humans for the production of honey and other honey bee products such as bee wax, natural honey propolis, cerume, royal jelly etc. [10, 11, 42]. It is an activity for economic gain, safeguarding and conservation of environment that is day by day flourishing for rural development [2, 43] it's very important source of income for rural areas [11, 44]. In Saudi Arabia ~ 9000 tons honey is produced from more than one million colonies maintains by 5000 beekeepers annually [45]. In a study, it is concluded that the first aim of 100% beekeepers is to produce honey. Minimum about 20% aims have to produce other products and about 50% beekeepers are aware about pollination service of bees and its importance [24]. Bees are the only organisms which have no competition with other animals for nectar [11] But shortage of

raw material is main problem for this subsector's development. It is very important to estimate the carrying capacity of an area for foraging behavior of honey bees because beekeeping depends upon the availability of maximum production of nectar, pollen, water and suitable climatic conditions [45, 46]. Optimum temperature for rearing process is 34.5°C [46]. For this reason, beekeepers move their colonies for better sources. Productivity depends upon the sources and minimum competition among bees for this there should be optimum distance between apiaries [45, 46]. In case of pollinators declining beekeepers play a major role by providing pollination service. Some crops require small number of pollinators therefore honey bees are very significant for those crops [24]. In developing countries those areas which have infertile soil and low productivity by agriculture sector especially rural areas resulting into food shortage so, for this reason they have enormous focus on non-agriculture activities such as beekeeping [11, 47] on tall wild trees for improving their income, livelihood and conserve the plants. Such type of beekeeping practice is very common in Zimbabwe. Successful beekeeping practice depend upon the modern methods of rearing in which moveable strong hives, healthy bees, good location and use of various miticides or other treatments for decreasing the mortality rate which is the evolution from traditional methods. Some activities are unfriendly for environment and are prohibited by Government, but beekeeping is eco-friendly practice and quick source of income with less investment [11, 61]. Women also participate with men in apiculture activities in different ways such as by cleaning, watering, in management [42]. There should be all information about good beekeeping practice for beekeepers. For information there are lots of web links which give good guidelines to beekeepers. Some links are given below in (Table 1).

Table 1. Some national and international Beekeeping organizations

Organizations	Web link
Tennessee Beekeeper's association (TBA)	http://www.tnbeekeepers.org/
The Florida State Beekeepers Association	http://www.floridabeekeepers.org/
American beekeeping federation (ABF)	http://www.abfnet.org/
African beekeeping resource center	http://apiconsult.com/
European Professional Beekeepers Association (EPBA)	http://www.professional-beekeepers.eu/
British Beekeepers Association	http://www.bbka.org.uk/
Beekeeping Development in Moldova.	http://outdoorplace.org/beekeeping/moldova.htm
Beekeeping Development in Ukraine	http://www.honeyo.com/org-International.shtml
Beekeeping Development in Fiji.	http://outdoorplace.org/beekeeping/peace.htm
Bees for Development	http://www.beesfordevelopment.org/
Eastern Apicultural Society (EAS)	http://easternapiculture.org/
Honey Packers and Marketers Association of Australia.	http://www.honeybee.com.au/
International Bee Research Association (IBRA)	http://www.ibrabee.org.uk/
Japanese Honey Bee Association	http://www.nihon-bachi.org/english/f2.htm
Apiculture New Zealand	http://apinz.org.nz/
Uganda national Apiculture development organization (TUNADO)	http://www.tunadobees.org/

Economic importance or income source

Economic value of honey bee is a global concern in this century [48]. Bee product, honey has high importance globally with respect to income source, by an estimation there is about 6 billion \$US annually earning in global market [10]. Rural people's income source depends upon many types of assets [11, 49]. An analysis of family member's occupation in Chitwan district Nepal is reported by [24] and concluded that the 54% family members occupation is agriculture, 25% are students, only small number 2.55% in business, 6% in services and 13% (Fig. 1) are in abroad services [24].

It means that large population is attached with agriculture sector not only in Nepal but also in some other countries. Therefore, by beekeeping practice we can improve our income source and rural livelihood [11]. Beekeeping is prime development tool and an additional source of wealth for farmer

communities by different bee products especially the commercial vast use of honey bee become a business globally in recent era [50, 51]. Large number of peoples are employed in beekeeping services, in 2012, 2,552 individuals are employed in U.S for beekeeping [35]. It is an immense source of raising income for both men and women e.g. in Kenya and in some other countries where women are empowered by different activities [42]. In some countries there are also beekeeper trainers such as Society of facilitator and Trainer (SOFT) which give training but rare [52]. In Zimbabwe there are many beekeeping projects are initiated by NGO's which will act as a milestone for raising economy. Women can use the different beekeeping materials for making secondary products. In an analysis of income by beekeeping in Chitanga village, Mwenezi District, Zimbabwe concluded that by beekeeping villagers collect (20 liters) raw

honey and packed it into (350 milliliters) bottles and sold in US\$3.50-\$5.00 each bottle. By this the annual income range of villagers is about US\$180.00-\$380.00 that is greater than one tone of maize production that is US\$285.00 [11]. In 2000, U.S earns \$14.6 billion from crops due to pollination service by honey bees [6, 36] and in 2010 it is estimated that there is about \$16.4 billion contribution by insect pollinators out of

which \$12.4 billion is due to honey bees [53]. Many western countries farmers take bees on rent at their prescribed rates for pollination service from beekeepers. Their rents(fees) are increasing day by day and it is a great economic benefit for beekeepers in Soviet bloc countries honey bees are consider as second currency due to earning from honey production [18, 35].

Figure 1. Family occupations in Chitwan district Nepal [24]

Honey bee sting

Honey bee have stinger it can sting the predator or person as defense strategy for themselves or colony. Its sting is very annoying, and causes localize pain, redness and swelling. It is not a major therapeutic dilemma for about 99% peoples, but it is a great threat to persons who are very sensitive to bee venom because it is a cause of allergic reaction. Hymenoptera sting basis allergic reactions are about 0.3-3.5% in adult population [22].

Threats to honey bee

There are lot of stress on honey bee colonies in all regions of the world therefore honey bee colonies are gradually declining (Table 2).

In 2006, according to a study 30% to 90% colonies are declined in USA due to these threats still the decline is continuing [56]. These threats cause serious economic loss throughout the world [18] There is a great honey bee colonies loss in summer seasons due to harsh weather conditions in different areas and regions. So, the selection of area is very important for beekeepers for avoiding

loss. In Saudi Arabia summer season is big hurdle for beekeepers when temperature reaches up to 45°C. Most suitable area can be selected by geographical information system by constructing a map [46]. Due to these threats number of honey bee colonies in U.S

since 1970s that are greater than 4 million decreases into 2.41 million and further decrease since 2006 [6, 32]. Despite these threats honey bee colonies are losses by difference in beekeeping practice [18].

Table 2. There are some common threats to honey bee colony depletion

Threats	Examples	References
Poor nutrition	pollen or nectar scarcity	[53, 54]
Parasites	<i>Varroa destructor</i> , wax moth, <i>Acarapis woodi</i> , <i>Apocephalus borealis</i> ,	[18, 19, 53, 55, 56]
Parasitic Fungi	<i>Ascosphaera Apis</i> , <i>Aspergillus niger</i> , <i>Nosema ceranae</i> and <i>Nosema apis</i>	[18, 23, 33, 53, 57]
Viruses	Acute bee paralysis virus (ABPV), Deformed wing virus (DWV), Kashmir bee virus (KBV) and Israeli acute bee paralysis virus (IAPV), Black queen cell virus (BQCV), Chronic bee paralysis virus (CBPV), Schmollenberg virus (SBV), they cause many diseases in bees having weak immune system.	[18, 53, 58]
Bacteria	Acid-Fast Bacilli (AFB), European foulbrood (EFB), septicemia and spiroplasma, <i>Melissococcus plutonius</i>	[18, 33, 53]
Pests	Beetles, skunks, raccoons, bears, and mice	[53]
Pesticides	<p>Insecticide: Acephate, Carbaryl, Cypermethrin, Deltamethrin, Diazinon, Dimethoate, Imidacloprid, Lambda-cyhalothrin, Malathion, Methomyl, Permethrin, Phosmet, Pyridaben, Spinosad, Thiacloprid, Tiamethoxam, Acetamiprid, Chlorpyrifos, Endosulfan, Phosalone, Clofentezine, Formetanate, Pyrimicarb etc.</p> <p>Acaricides: Bifenazate, Dicofol, Spiromesifen etc.</p> <p>Fungicides: Azoxystrobin, Boscalid, Captan, Chlorothalonil, Cymoxanil, Fenamidone, Iprodione, Mancozeb, Myclobutanil, Pyraclostrobine, Pyrimethanil, Zineb, Zoxamide etc.</p> <p>Herbicides: 2, 4 D, Clomazone, Chlopyralid, Fluazifop-p-butyl, Glyphosate, Linuron, Metribuzin, Paraquat, Trifluralin etc.</p> <p>And others include organochlorine, carbamate, organophosphorus, and pyrethroid pesticides</p>	[59, 60]
Climatic changes	Drought, increasing or decreasing temperatures, changes in rainfall, Wind	[35, 51, 61]

Conclusion and Recommendations

After this through study it is concluded that tiny creatures, honey bees have great importance in our lives due to their thousands of services including bee products (Honey, bee wax, propolis, royal jelly etc) and

ecosystem services such as pollination and help in raising our livelihoods. Recently pollination service is declining due to many threats especially diseases which is very alarming situation because many crops of our agriculture sectors depend upon them. If

pollinators are vanishing so we will deprive of our food. Beekeeping is large sector for earning, but it requires the awareness and good beekeeping practices. Beekeeping practice including floral condition of particular area, types of honey bee of that area, bee Biology, bee keeping tools, handling practice of honey bees, seasonal management for colonies, awareness about honey bee diseases and its management. In current scenario there is lacking beekeeping practices and especially gender wise discrimination otherwise, it is huge sector for earning livelihood for developing countries so, there is an enormous need to pay attention to this sector. More researches should be done for highlighting the economic value of Honey bees. There is an immense need to give awareness to peoples that how they raise their livelihoods by beekeeping practice. Government and NGO's should take collaborative steps for new policy and planning for beekeepers. Besides this there should be funding source for beekeepers to increase this eco-friendly culture.

Authors' contributions

Conceived the idea: MF Malik, Wrote the Paper: S Naz & MF Malik, Proofread the data: M Hussain, S Afsheen & R Iqbal, Corresponding author: S Naz

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