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Theory and Research in Agriculture, Forestry and Aquaculture Sciences

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Chapter 1

SKIN COVER SYSTEM AND HISTOLOGICAL STUDIES CONDUCTED ON TURKISH LOCAL SHEEP BREEDS

Selçuk Seçkin TUNCER[1]

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1. INTRODUCTION

Skin protects animal body against external effects and serves a kind of cover protection mechanism. Besides protective task against mechanical effects, skin has various other functions including regulation of body temperature and water (with sweat glands), sensation, prevention of toxic effects, D_3 vitamin synthesis. Through immune cells in dermis layer; contributes to respiratory system with BALT (Bronchus Associated Lymphoid Tissue), to digestive system with GALT (Gut Associated Lymphoid Tissue), to immune system with SALT (Skin Associated Lymphoid Tissue) (Artan, 1988).

Skin is defined as a large organ in which body water of living species is stored. Skin water content was reported as 69.7% in Merino, 78.1% in Dağlıç and 77.9% in Akkaraman sheep. The rest of skin is composed of protein, lipid and minerals (Artan and Sunaçoğlu, 1986). Collagen, constituting 60-65% of dry matter of sheep skin, is the primary protein of the skin (Philips, 1954). Collagen ratio was reported as 64.0% in Dağlıç, 67.0% in Karayaka, 69.3% in Kıvırcık, 69.9% in Morkaraman and 59.3% in Merino sheep. In another research, collagen ratio was reported as 63.1% in Dağlıç and 64.0% in Akkaraman (Hakimoğlu, 1990). Besides protein constituting almost all of the skin dry matter, sheep skin also contains significant quantity of lipid and lipid quantity vary based of species. Lipid is not homogeneously distributed everywhere in the skin. Lipid ratios were reported as between 3-5% in cattle skins, 20-30% in British local sheep skins and 3-5% in goat skins (Eker and Artan, 2000). In previous studies conducted on Turkish sheep races, lipid ratio was reported as 8.3% in Akkaraman and Dağlıç sheep and 7.2% in Merino sheep. Physiologically, lipids are mostly encountered in neck and shoulder sections, then in the regions close to both sides of the ridge line. Histologically, lipids are mostly encountered in hypodermis, then in the region of side in which stratum reticula is close to hypodermis (Artan and Sunaçoğlu, 1986). Lipid ratios of different skin layers were reported as 22% for papillary layer, 32% for reticular layer and 93% for hypodermis layer (Eker and Artan, 2000). Skin ash ratio was reported as 3.8% in Akkaraman, 6.3% in Merino and 6.7% in Dağlıç sheep.

As reported by Artan (1980), while histological assessment of skin, researchers mostly focused on:

a) Thickness and density of connective tissue fibers,

b) Angle of connective tissue fibers with the surface,

c) Thickness of the skin and sub-layers,

d) Connection characteristics of main and sub-layers with each other,

e) Hair follicles and skin glands-related characteristics.

2. SKIN STRUCTURE

Skin is composed of epidermis, dermis and hypodermis layers (Figure 1).

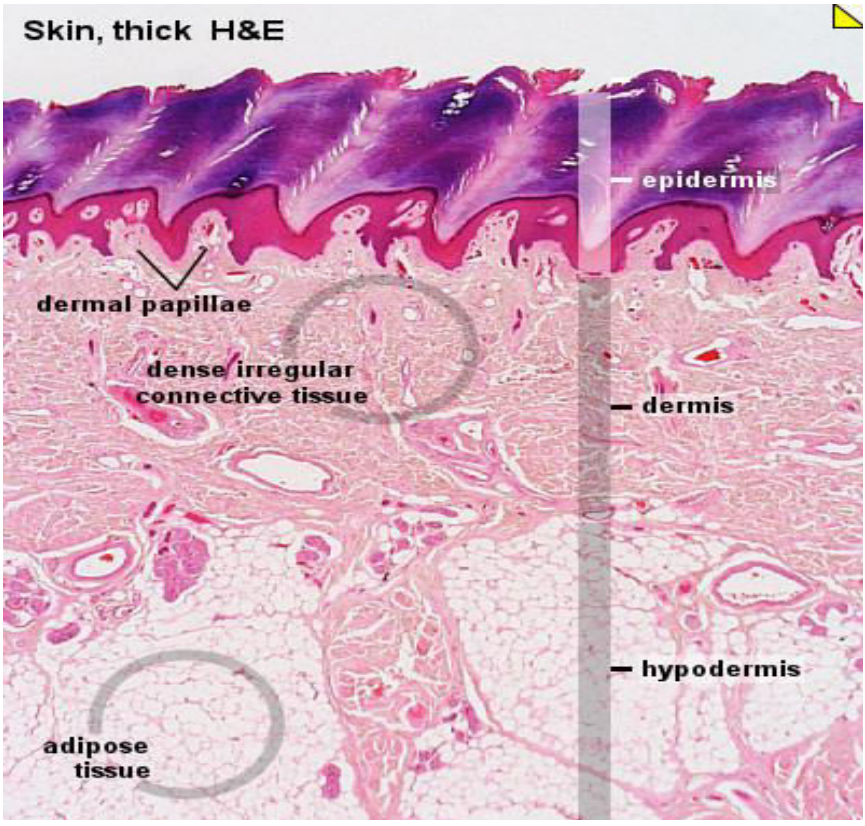

Figure 1. *Skin layers (Anonymous, 2020a).*

2.1. Epidermis:

Epidermis was defined for the first time by Malpighi (1628-1694). Malpighi divided epidermis into two layers: an inner layer (stratum Malpighi) in which living cells exist and an outer layer (stratum corneum) in which horn-like cells without nuclei exist. Later studies divided this layer into more sub-layers (Das, 2007).

Epidermis constitutes the outermost layer of the skin and it is an elastic epithelium cover with keratinized structure (Dağlıoğlu and Bayramlar, 1988). As can be seen in Figure 2, stratum basale and stratum spinosum constitute an important portion of the skin; stratum granulosum, stratum lucidum and stratum corneum constitute smaller portion of epidermis (Tanyolaç, 1999).

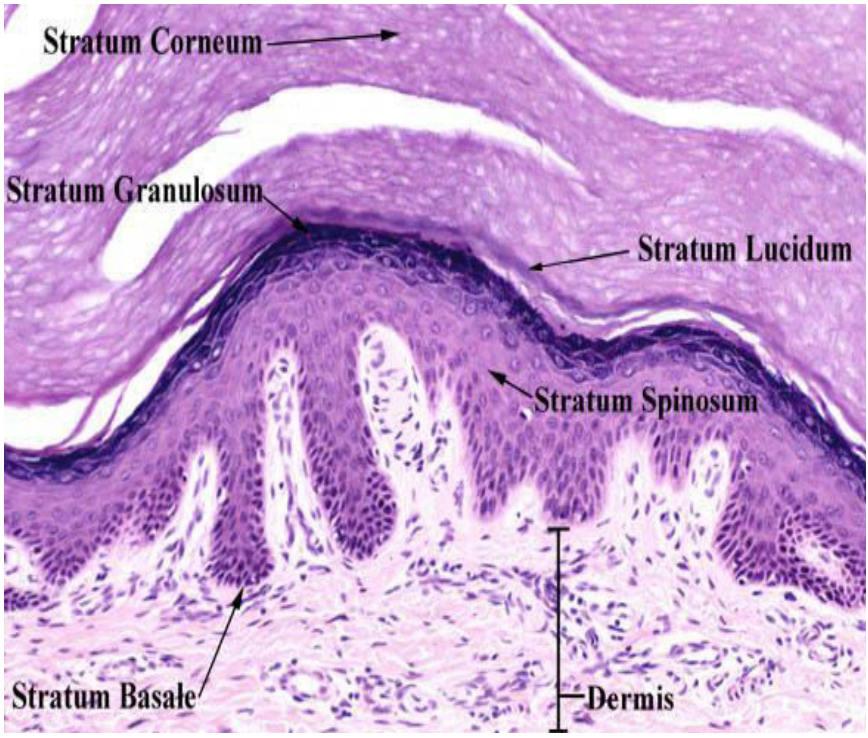

Figure 2. *Layers of epidermis (Anonymous, 2020a).*

Epidermis is thicker in hairless regions and skin-mucosa transition sections and dermis layer can contact epidermis only through the capillary extensions so called as microscopic papillary (Fırat, 1994; Armutak and Dağlıoğlu, 1995; Tanyolaç, 1999). Epidermis is thinner in densely haired sections of the skin and contact with the dermis is fixed through a smooth surface (Tanyolaç, 1999). Average epidermis thickness was reported as 42µ in Merino rams (Kozlowski and Calhoun, 1969), between 11.8-13.2µ in Dağlıç and between 16.8-25.0µ in Akkaraman sheep (Artan, 1980), 24.9µ in Australian Merino (Britt et al., 1985) , 20.26µ in İvesi sheep, 21.82µ in Sakız sheep (Dağlıoğlu and Bayramlar, 1988), 22.24µ in Karacabey Merino (Özfiliz, 1992), 15.25µ in Kıvırcık, 17.00µ in Merino, 12.65µ in Karayaka and 13.80µ in Morkaraman sheep (Artan et al., 1995). Epidermis thickness was reported as 20.83µ for the ridge section of Karacabey Merino sheep, 26.67µ in Kıvırcık sheep (Özfiliz et al., 1997), as between 18.00-25.00µ based on body section and season in Hampshire sheep, as between 22.00-44.00µ in Akkaraman sheep, between 18.00-24.00µ in Konya Merino sheep (Kurtdede and Aştı, 1999), 22.08µ in Karayaka sheep (Zık et al., 1999). In a study conducted with Tuj sheep, the greatest epidermis thickness was reported for belly section, the lowest for ridge section and mean value was reported as 25.3µ (Kocamış and Aslan, 2004). Epidermis thickness of Kıvırcık sheep was reported as between 21.78-22.44µ (Eren et al., 2012).

2.1.1. Stratum basale

It is the lowest layer of cover epithelium and composed of single line of prismatic cells. Epidermis, a veinless tissue, sits on cytoplasmic extensions of this layer and connective tissue right beneath and feed through diffusion from the vessels in connective tissue (Açıkalın, 1995). Spearmen attributed easy separation of epidermis from the dermis through the stratum basale at high temperature to looseness of this connection (Artan, 1980). This layer is able to compensate cellular losses in upper layers though the ability of regeneration. Melanin pigment is produced by melanocyte cells in connective tissue and accumulated in colored regions of the skin. It reaches up to keratinocytes through abundant extensions. Skin dark color is resulted from melanin pigment, redness from rich blood vessels and yellow color from carotene. Melanin pigment regenerates against the harmful effects of ultraviolet rays, accumulates in keratinocytes and protects the organism. In this layer, there are Merkel cells closely associated sensory nerve tips (Tanyolaç, 1999).

2.1.2. Stratum spinosum

Largerhans cells, seen for the first time by German scientist Paul Langerhans in 1868 and named after him, are located in this layer and aids in immune processes of the body (Das, 2007). This layer is composed of polygonal cells and cells send intercellular extensions to establish contacts with each other. Since these extensions have a spinal appearance, this layer is so called as “stratum spinosum” meaning spiny layer (Sobotta and Hammersen, 1994). Similar to Stratum basale layer, cells have regeneration ability through mitotic division. Therefore, two layers are together so called as “stratum germinativum” (germinative layer) (Açıkalın, 1995). Stratum spinosum initiates keratinization through the RNAs in cell cytoplasm.

2.1.3. Stratum granulosum

Since the cells have small keratohyalin granules, this layer is called as “stratum granulosum” (Sadler, 2005). Basophil-stained keratohyalin granules could clearly be monitored in microscope (Açıkalın, 1995). Stratum granulosum is composed of couple rows of squamous cells one on top of the other. Excessive granule accumulation in cells may damage nucleus. Granule particles in keratinocytes move into cell membrane and release their contents into intercellular space. Such a case then generates a barrier for water in intercellular space. Such a characteristic is specific only for this layer of epidermis (Tanyolaç, 1999).

2.1.4. Stratum lucidum

It is a thin and translucent layer (Açıkalın, 1995). Since the cells were fully died out, it seems to be a homogeneous layer. Physically melted and chemically modified keratohyalin is called as “eleidin” in this layer (Tanyolaç, 1995). Kelly

(2004) indicated that contrary to hairy or hairless regions of the other epidermis layers, stratum lucidum layer could be monitored only in hairless regions of the skin. According to Artan (1980), since stratum lucidum could more remarkably be monitored in thicker sections of the epidermis, it is more clearly monitored in skins of Akkaraman sheep than Dağlıç sheep.

2.1.5. Stratum corneum

This layer constitutes the outermost layer of epidermis and composed fully of death cells. This layer is so called as "stratum corneum" meaning horn-shaped layer (Açıkalın, 1995). In this layer, keratohyalin granules fused tonofilaments, cell membranes thickened, nucleus and the other organelles are totally evanished (Sabotta and Hammersen, 1994). The structure shaped through fusion resulted in formation of soft keratin. Therefore, exfoliation is encountered. Soft keratin contains less sulphur and has keratohyalin granules, thus different from hard keratin. Thickness of corneum layer vary with the mechanic impacts encountered in different sections of the body (Tanyolaç, 1999).

2.2. Dermis:

It is also called as "Corium" or "cutis". Structure is largely composed of collagen connective tissue. There are blood vessels, pigment cells, small nerves, sweat and sebaceous glands, hair follicles and their muscles (arrectorpili) in this layer. This layer is used in tannery industry. Especially in leather manufacture from the skin, tight lattice formed by collagen fibrils brings about a physical endurance (Demirsoy, 2003). Dermis is composed of two layers without an explicit boundary between them. These are upper layer "stratum papillare" close to the surface and in which there are epidermis-originated structures because of the position of this layer and "stratum reticulare" close to hypodermis with intensive connective tissue (Artan, 1988; Fırat, 1994). Dermis thickness was reported as 2615µ in Akkaraman sheep, 1957µ in Dağlıç sheep (Artan, 1980), 2670µ and 3094µ respectively in neck section of İvesi and Sakız sheep (Dağlıoğlu and Bayramlar, 1988). Dermis thickness at neck, shoulder and belly sections of Karacabey Merino was respectively reported as 2620µ, 2890µ and 2100µ (Özfiliz, 1992). Dermis thicknesses at neck sections of Dağlıç, Karayaka, Kıvırcık, Morkaraman and Merino sheep were respectively reported as 803.04µ, 1083.10µ, 1690.13µ, 1326.01µ and 2245.25µ (Artan et al., 1995). Dermis thicknesses at neck, shoulder and ridge sections of Kıvırcık and Karacabey Merino sheep were respectively reported as 3150µ and 3045µ, 2975µ and 2625µ, 2537µ and 2329µ, 3245µ and 3854µ (Özfiliz et al., 1997). Dermis thicknesses of Konya Merino, Akkaraman and İvesi sheep were respectively reported as 2500µ, 2750µ and 3300µ in neck, as 2500µ, 2700µ and 3250µ in ridge and as 2450µ, 2650µ and 2700µ in leg (Kurtdede and Aştı, 1999). Dermis thickness at ridge section of Karayaka sheep was reported as 3038.16µ (Zık et al., 1999).

2.2.1. Stratum papillare

This layer is composed of dense lattice of fibers, thus has a stylish structure (Lanning, 2020). This layer is the connection surface of epidermis and dermis and so called as "gren face" because of the nice appearance brought to the skin (Tanyolaç, 1999). Increase in density and height of dermal blisters increase the roughness of gren face. This layer contains reticulum fibers, thin collagen fiber bundles and elastic fibers. Additionally, there are fibrocyte, macrophage, mastocyte, plasmacyte and pigment cells. This layer is also rich in blood vessels and sensory nerve tips. Thickness of stratum papillare was reported respectively as 1755 and 1149µ in Akkaraman and Dağlıç sheep (Artan, 1980), 1790µ in İvesi sheep, 1495µ in Karacabey Merino, 1960µ in Akkaraman sheep (Kurtdede and Aştı, 1999), 2162µ at ridge section of Karayaka sheep (Zık et al., 1999), 1210µ in Tuj sheep (Kocamış and Aslan, 2004) and as between 884-1079µ in Kıvırcık sheep (Eren et al., 2012).

Stratum papillare layer is assessed in 3 sub-layers based on skin glands positioned at different depths, hair follicles, position and characteristics of hair muscles:

✓ 1st sub-layer: Thickness vary between 0.2-100µ. It is a layer just beneath the epidermis and there are the thinnest collagen fibers in this layer (Artan, 1980). There are sweat gland ducts opening to the surface and neck sections of hair follicles (Artan, 1988).

✓ 2nd sub-layer: Thickness vary between 1-4µ. It is a layer with the greatest quantity of elastic fibers (Artan, 1980). Elastic fibers are sometimes greater than collagen fibers and sebaceous glands are the most distinctive characteristics of this layer. The collagen fibers with a complex lattice appearance are thicker in this layer than in the 1st sub-layer (Artan, 1988).

✓ 3rd sub-layer: It is the section of the dermis in which the most distinctive difference is encountered. The factors constituting this difference include; position of layer base at the terminal boundary of epidermal formations and formation of a loose (weak gren) irregular lattice by collagen fibers with decreasing elastic fibers (Artan 1980; 1988).

2.2.2. Stratum reticulare

This layer can be expressed as the area extending from sweat gland and hair follicles (except for the ones extending up to hypodermis) to hypodermis (Artan, 1988). Collagen fibers spreading the entire skin form a regular lattice with elastic fibers and such a lattice structure distinguish this layer from stratum papillare. In species with a wide stratum reticulare (cattle and horse), the skin is used as leather raw material (Tanyolaç, 1999). Stratum reticulare thickness was reported respectively as 968µ and 808µ in Akkaraman and Dağlıç sheep (Artan, 1980), respectively as 880µ, 2358µ, 820µ, 875.8µ, 741µ and 753-857µ in İvesi (Dağlıoğlu and Bayramlar, 1988), Karacabey Merino (Özfiliz et al.,

1997), Akkaraman (Kurtdede and Aştı, 1999), Karayaka (Zık et al., 1999), Tuj (Kocamış and Aslan, 2004) and Kıvırcık (Eren et al., 2012) sheep.

This layer can be assessed in 2 sub-layers (4th and 5th sub-layers as the follow up of stratum papillare layer) (Artan, 1988; Özfiliz et al., 1997):

✓ 4th sub-layer: It a layer in which elastic fibers are the least encountered (Artan, 1980). The layer is poor in blood vessels and the thickest collagen fibers of the skin formed a regular and tight lattice (Artan, 1988; Tanyolaç, 1999).

✓ 5th sub-layer: It is the neighboring section of dermis with hypodermis. Thinner collagen fibers form an irregular lattice structure with a smaller number of elastic fibers. Rich blood vessels distinguish this layer from the 4th sub-layer (Artan, 1988).

2.3. Hypodermis:

It attaches the skin to underlying connective tissue (Artan, 1988). It is characterized by adipose cells positioned within loose connective tissue lattices and these cells are encountered as highly varicose in fattened animals (Tanyolaç, 1999). With an elastic and thick fat layer, it plays a protective role (Armutak and Dağlıoğlu, 1995). The section with adipose cells, serving a source of feed and energy, is so called as stratum adiposum and the underlying section, attaching the skin to the body, is so called as stratum fibrosum (Tanyolaç, 1999). Fat ratio of sheep skin vary between 5-30% (Yılmaz et al., 2001) and hypodermis stores about 93% of skin fat (Eker and Artan, 2000).

3. Skin Glands

Although skin glands are formed by the production and determination of special inducer proteins in the dermis layer, they are in principle considered to be of epidermis origin (Demirsoy, 2003). These glands consist of 2 basic gland groups, namely sweat and sebaceous glands, and the mammary glands, the most important and largest of which is considered a type of sebaceous gland (Artan, 1988; Demirsoy, 2003).

3.1. Sebaceous Glands

The sebaceous glands in the skin are lump-shaped, alveolar-type holocrine-secreting glands (Dağlıoğlu and Bayramlar, 1988) (Figure 3).

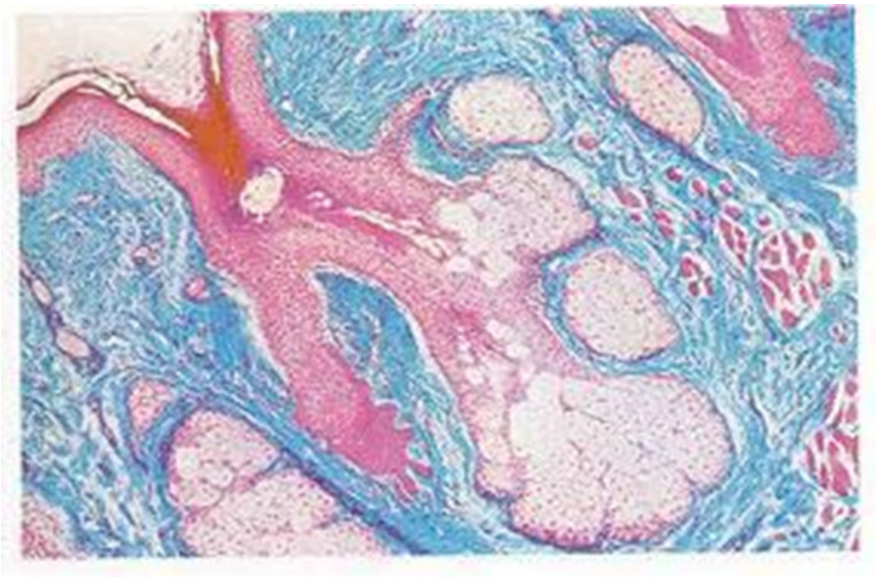

Figure 3. *Holocrine sebaceous gland in branched alveoli type (Sabotta and Hammersen, 1994).*

Wherever there are hair follicles in the stratum papillare layer, there are sebaceous glands and their secretions are usually emptied into the hair follicle (Dağlıoğlu and Bayramlar, 1988; Demirsoy, 2003). Although sebaceous glands are found as two pouches in primary follicles in small ruminants and sometimes as single sac in secondary follicles, they are mostly absent (Artan, 1988; Dağlıoğlu and Bayramlar, 1988). It has been reported that the sebaceous glands develop most in the summer months, and regress in the winter months (Zık, 1998). The sebaceous glands surrounded by a basal membrane are released from the secretory ducts lined with a single of flat epithelial layer (Artan, 1988). Skin quality of Akkaraman sheep was deteriorated as a result of excessive secretion caused by sebaceous glands with age (Arvas, 1981). Regardless of the presence of the hair, the sebaceous glands can also be exposed from the lips, nose, ears and reproductive organs (Demirsoy, 2003). In sheep, these sebaceous glands are infraorbital (gll. Sinus infraorbitalis) and groin (gll. Sinus inguinalis), earwax (gll. Ceruminosae), anal (gll. Circumanales), subcaudal organ (gll. Caudae), interdental (gll sinus interdigitalis) glands can be given as an example (Artan, 1988).

3.2. Sweat Glands

The sweat glands concentrated at the bottom of the hair follicles in the papillar layer of the dermis (Dağlıoğlu and Bayramlar, 1988) consist of tubular glands that make long-thin folds and are surrounded by capillaries (Demirsoy, 2003). It discharges secretions through a pore (hole) that opens to the outer surface with or without follicle with curved secretory channels (Artan, 1988; Demirsoy, 2003). These secretions mainly regulate heat loss (cooling by

evaporation) and excretion (discharge of metabolites) (Schummer et al., 1981). While sweat glands are observed between and under the hair follicle bulbs in Kivircik and Karacabey Merinos sheep (Özfiliz, 1992), active and passive sweat glands are observed in Karacabey Merinos every season (Zık, 1998).

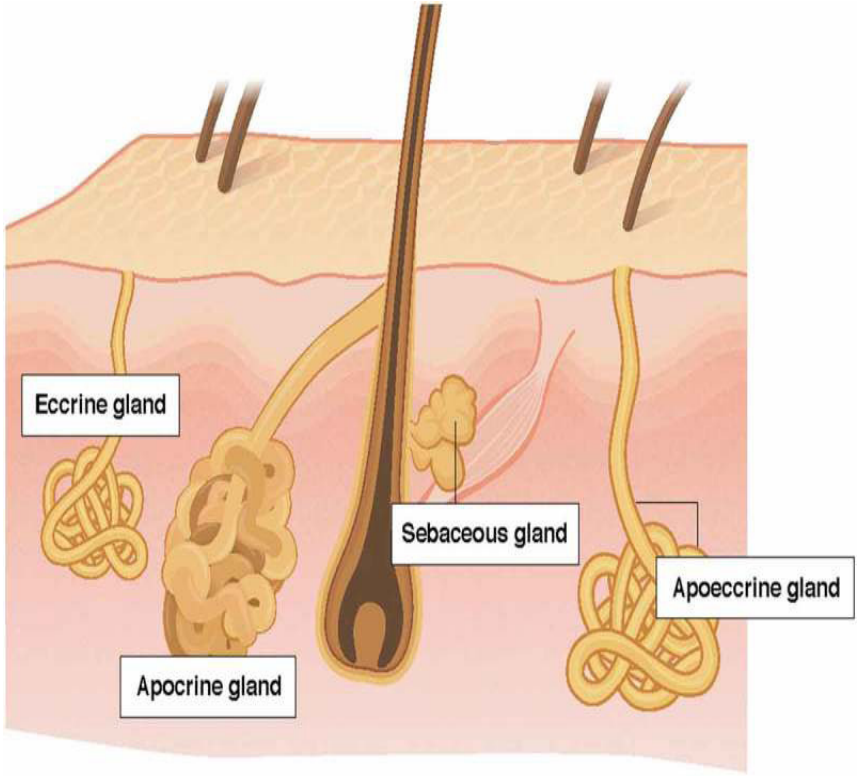

Figure 4. *Apocrine, eccrine and apoecrine glands in the axilla (Baker, 2019).*

There are three types of sweat glands, eccrine, apocrine and apoecrine, depending on their region and secretory characteristics (Figure 4). Eccrine glands are generally known as the small gland type and are the most common type of sweat gland. Eccrine sweat glands are the most abundant sweat glands in the body. It is distributed almost over the entire body surface area and is responsible for the highest volume of sweat excretion. Apocrine and apoecrine sweat glands, on the other hand, play less role in general sweat production since they are limited to certain parts of the body (Baker, 2019). An apocrine sweat gland is usually associated with hair follicles in dense hairy areas such as the armpit and genital area (Anonymous. 2020b). Although it is called the sweat gland, the main function of apocrine sweat glands is not sweating. They create their own unique body odor due to their ingredients. With their secretions, these glands have functions such as marking the habitats of animals, danger signals, warning and sexual attraction (Kalkan, 2018).

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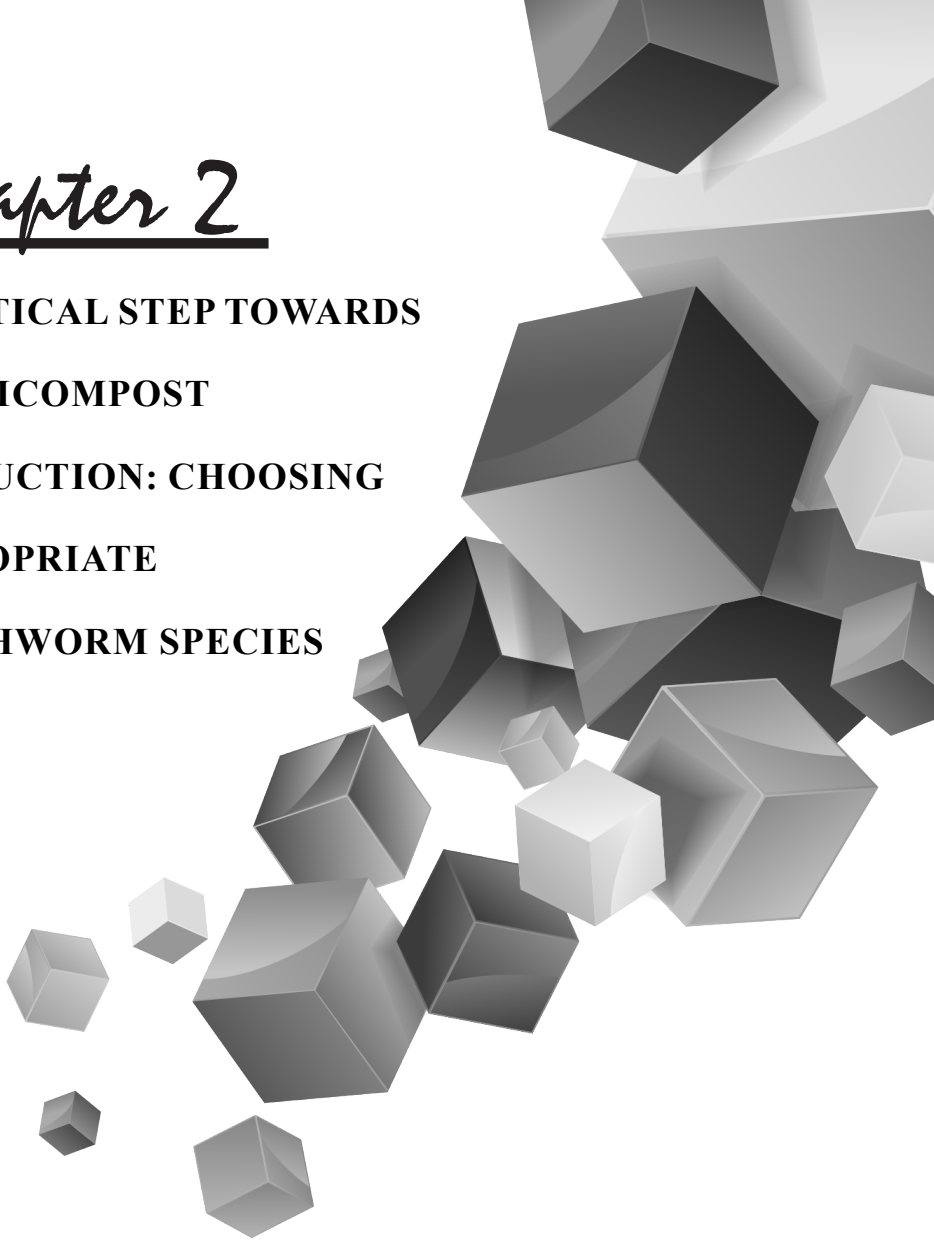
Chapter 2

A CRITICAL STEP TOWARDS VERMICOMPOST PRODUCTION: CHOOSING APPROPRIATE EARTHWORM SPECIES



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Vermiculture is a growing and developing technology all over the World. Many countries and companies have been going on to produce and promote this high-quality organic material. Also, many financiers, whether small or global have been investing in the market. Moreover, small farms aim to produce their fertilizer to use in their lands. However, there is a vital problem negatively affecting all the processes. The top players of vermiculture technology, earthworms, have very different life cycles and adaptability to environmental factors. Earthworm activity, density and biomass tend to increase with increment temperature at high soil water content, while extreme climate conditions, such as drought and flooding, have detrimental effects. Climate Change may mitigate the invasion of earthworms at higher altitudes and latitudes, while dryer and warmer regions might limit the performance of earthworms (Singh, Schadler, Demetrio, Brown and Eisenhauer, 2019: 114). Due to their different characteristics, some of them prefer a tropical climate while others have high productivity in low temperate regions. Other factors affecting population density and activity of earthworms are soil fertility, moisture, management practice of land and food source. So, choosing appropriate earthworm species is the first step to success in the production of vermicompost.

1. Why is vermiculture a favored technology?

Rapidly growing industrialization has coupled with excessive increasing human population and escalating urbanization has revealed a global environmental crisis. Soil waste is one of the most important problems in all but a few regions all over the World. The World Bank stated that the consistent solid waste per year is nearly 1.3 million tons for urban in 2012, and it is estimated to be able to achieve up to 3 million tonnes in the first quarter of the 21st century (Das, Lee, Kumar, Kim, Lee, and Bhattacharya, 2019: 658). The countries that suffer from the solid waste problem have been trying to develop new strategies and technologies, including the source mitigation, material recycling, waste to energy, incineration, landfill dumping and composting, however, some of these treatments would cause various environmental damages (Hooks, Hrysko, Strickland, Dixon, Karaye, Kirsch, Horney 2020: 119; Zhang, Duan, Sun, Li, Zuo, Mao, Liu and Niu, 2020: 119242). Even so, the vermicomposting, one of these solutions, is a considerable efficient technique that converts solid waste into valuable organic material.

Vermicompost is the name of the final organic product obtained by passing almost any organic material through the digestive system of the earthworms (Joseph, 2019). Therefore, vermicomposting is a mesophilic process,/of conducting the interaction of earthworms and microorganisms. Vermicomposting, also called vermiculture, is not only an effective technology involving decomposition of organic fraction of waste in an eco-friendly method but also can be handled, used for any agricultural lands as a qualified fertilizer and stored for a long time (Edwards, 2011; Singh, Embrandiri, Ibrahim, and Esa, 2011: 423). Besides, vermiculture that enables to convert any organic waste into

a value-added product is a low-cost and easily applicable technique (Ceritoglu, Şahin and Erman, 2019: 230; Uçar and Erman, 2020: 96).

Vermicomposting has been proved to be successful for processing paper industry waste (Amouei, Yousefi and Khosravi, 2017: 1; Karmegam, Vijayan, Prakash and Paul, 2019: 718), sewage sludge and solids from wastewater (Villar, Alves, Perez-Diaz and Mato, 2016: 409; Soobhany, 2019: 118413), urban residues, and food and animal wastes (Sharma and Garg, 2018: 708; Yogananda, Parama, Prakash and Thimmegowda, 2019: 1; Li, Bhat, Li, Cui, Wei, Yamada and Li, 2020: 122816), food industry wastes (Garg, Suthar and Yadav, 2012: 437; Esmaeili, Khoram, Gholami and Eslami, 2020: 118523) and horticultural residues from plants (Bidabadi, 2018: 1; Gupta, Prakash, Gupta and Nazareno, 2019). Moreover, various researches stated that vermicompost has superior traits and effects compared to the other composting materials (Hanc and Dreslova, 2016: 186; Ceritoglu, Şahin and Erman, 2018: 607; Rekasi et al., 2019: 121861).

2. Morphology and Classification of Earthworms

Earthworms play a key role in the decomposition of organic matter, aeration of soil layers, modifying the structure, and finally constituting the composition of the flora. According to the new classical system determined by Blakemore (2006), more than 6,000 species of terrestrial earthworms are determined and designated, however, the number of synonyms is not exactly known.

The behavior, life cycle, need for reproduction, and response to ecological conditions show differences among earthworm species. The production number of cocoons, incubation, and maturity time, needed time for the decomposition of organic matter, and growth rate significantly vary among earthworms and these traits have a vital role in choosing earthworm species in vermicomposting. The biology of earthworms was described by Stephenson (1930) as starting from the head, possessing a lobe-like prostomium, to the anal opening, which is at the last segment of the body. The earthworms have a long tubular shaped gut that begins on the first segment (from the mouth) and ends at the last segment in which the anus is placed (Edwards and Bohlen, 1996). The digestive system consists of various structures including mouth, pharynx, esophagus, gizzard, stomach, intestine, and anus. This effective digestive system has a key role in the vermicomposting process (Kiyasudeen, Ibrahim and Ismail, 2020: 277). A schematized model of the digestion system of earthworms was given in Figure 1.

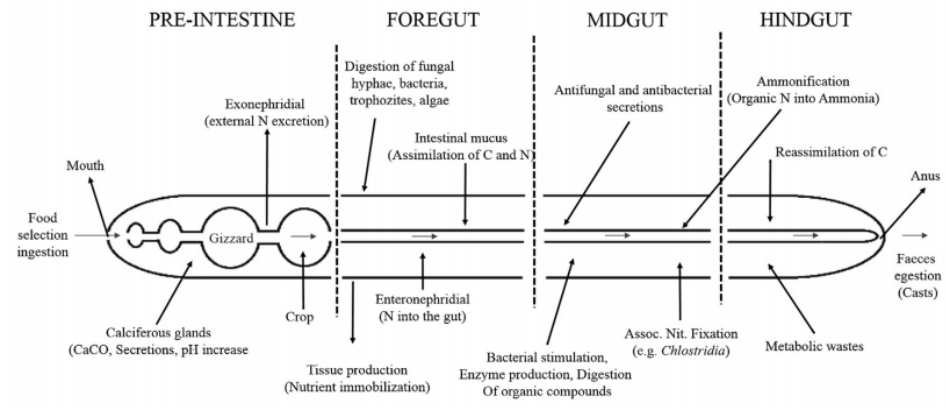

Figure 1. A schematized model of the digestion system of earthworms (Brown, Doube and Edwards, 2004, 213).

Earthworms are generally classified into 3 main categories ecophysiologically. The worms that constitute 1th group and are called as anecic build permanent deep burrows and visit the soil surface to find plant materials for food. The topsoil-dwelling (upper 10-30 cm of soil) worms that eat burrow and cast within the soil are placed in the 2nd group and called as endogenic. The 3th group consists of earthworms living in compost or leaf litter (organic horizon), feeds decomposing soil organic matter, and is called as epigeic (Lee, 1985). The most suitable earthworm species for vermicompost production are in the epigeic group. Epigeic earthworms are generally pigmented and small. However, epigeic earthworms have high metabolic activity and productivity that enable them to adapt to different ecological conditions. Also, they have high rates of consumption and assimilation of organic matter. Some of the remarkable earthworm species in epigeic lumbricids are *Eisenia fetida*, *Eisenia andrei*, *Eiseniella tetraedra, Dendrobaena veneta*, *Dendrobaena hortensis*, *Allolobophoridella eiseni*, *Dendrobaena octaedra* and *Dendrodrilus rubidus*. The summary of the characterization of earthworms, divided into categories were given in Table 1.

Table 1. Characteristics of earthworms used by Bouche to distinguish the ecological type

Category	Epigeics	Anecics	Endogeics
Body	small	Medium	large
Longitudinal contraction	Nil/none	developed	least developed
Burrowing	reduced	strongly developed	developed
Sensitive to light	sensitive	Medium	tolerant
Mobility	rapid	Medium	slow
Skin moistening	developed	developed	feeble

Productivity	high	Medium	low
Maturation	rapid	Medium	low
Survival of adverse	as cocoons	true diapause	by quiescence
Respiration	high	Medium	low
Pigmentation	homochromatic	dorsal and anterior	absent

Species of earthworm used in vermicomposting have a vital role in the process. So, the selection of suitable species for the degradation of organic waste is a great matter of concern and is substantial for getting a better product. Some of the important characteristics that must be considered before starting to vermicomposting are, the minimum gut transmit process, consumption, digestion and production of organic matter in a high rate, the rapid growth of species, adaptability to colonize used wastes, and high productivity of earthworms (Ali, Sajid, Khalid, Riaz, Rabbani, Syed and Malik, 2015: 1050). Indeed, a few special earthworm species have these vulnerable characteristics and few of them are mostly used for vermicomposting, including *Eisenia fetida*, *Eisenia andrei*, *Dendrobaena* veneta, *Lumbricus rubellus*, *Perionyx excavatus, Eudrilus eugeniae, Polypheretima elongata* and *Drawida nepalensis* (Dominguez and Edwards, 2011). Population density and activity of earthworms are influenced by various environmental factors, including temperature, soil fertility, moisture, management practice of land and food source (Van Groenigen, Lubbers, Vos, Brown, De Deyn, Van Groenigen, 2014: 6365). Especially the optimum temperature and moisture have a vital role in lifespan and cycle. The appropriate earthworm species exhibits diversity depending on climatical traits of the regions in which *E. eugeniae*, *P. hawayana*, *P. excavatus* and *P. elongata* are generally used in the tropics, while *E. fetida, E. andrei, D. rubidus, D. veneta, L. Rubellus* and *D. nepalensis* are preferred in the hot regions (Kumar, 2005).

3. Used Special Earthworm Species

Although many earthworm species might be used in vermicompost production, some of them are not appropriate for this process. Some special earthworm species were investigated in this chapter because they have different characteristics that provide some advantages. The most important traits are defined as high productivity, rapid growth and adaptation to ecological factors. So, while choosing suitable earthworm species, these characteristics should carefully be considered.

3.1. *Eisenia fetida* and *Eisenia andrei*

Also known as Red California worm, *E. fetida* and *E. andrei* species are mostly used in vermicomposting because they are almost ubiquitous in all over, they have a high tolerance to fluctuation in temperature and moisture range, their life cycles are short and their reproduction ability is quite high. All requirements

of these two species are almost equal and they are morphologically similar, except for a difference in pigmentation. Thought their life cycles and productive potential are not significantly different, the cocoon production and growth rates of *E. andrei* are higher than *E. fetida* (Dominguez, Velando and Ferreiro, 2005: 81). So, small producers might prefer this species to start vermicompost production due to its high productivity.

Optimum temperature, moisture and life-cycle (from cocoons to adult) requirement of these species are also the same and nearly 25 °C, 65-90% and 45-51 days, respectively (Cincin and Agdag, 2019). Maximum lifespans are nearly between 4.5-5.0 years in optimum ecological conditions. *E. fetida* and *E. andrei* species are quite suitable for mid-rail countries. However, the growth and productivity of these species might be negatively affected in the regions that have very high altitude and precipitation. Thus, these earthworms are suitable for the Mediterranean, Aegean, a part of middle and east Blacksea, not very high parts of Central Anatolia regions. However, they should not be preferred for eastern Blacksea, Southeastern Anatolia and a wide part of Eastern Anatolia regions of Turkey.

Bondhare and Desai (2019: 556) determined that productivity and growth rate of *E. fetida* is higher than *L. rubellus* under the controlled condition that is constituted in a room in which average temperature and moisture 21-28 °C and 60-80%, respectively. In another study, clitellum which is a part of worm shaping annular and is kept productivity organs started to grow 1 week earlier of *E. fetida* than *L. rubellus*. Also, hatching success rates of cocoons (86.6%) and the number of hatchling per cocoon (3.3±0.57) were higher recorded by *E. fetida* than *L. rubellus*. Podolak, Kostecka, Mazur-Paczka, Garczynska, Raczka and Szura (2020, 40) researched the life cycle of *E. fetida* and *D. veneta*, and stated that the total biomass was higher for *D. veneta* (18.568 ± 1.867 g) than *E. fetida* species (7.263 ± 1.786 g) whereas the number of cocoons per mature individual was higher for *E. fetida* (8.6) than *D. veneta* (8.2) throughout 52 weeks. Ali and Kashem (2018, 8110) pointed out that *E. fetida* has a higher reproduction ability compared to *E. eugeniae* and noteworthy suitable for the decomposition of organic wastes.

3.2. *Dendrobaena veneta*

Dendrobaena veneta is another largely used species in vermicomposting. Even though it is not a very reproductive species, it rapidly grows. So, *D. veneta* is a vulnerable species for companies aiming for commercial production. Moreover, *D veneta* is a substantial organism for soil fertility because it has a high nitrogen-production potential. It was determined that total nitrogen sources in vermicompost increased between 45-55% by *D. Veneta,* compared to composting (Degefe, Mengistou and Mohammed, 2016: 884). Although it prefers to mild temperatures 15-25 °C, it has a wide moisture tolerance. *D. veneta* needs about 65 days to reach sexual maturity (Podolak et al., 2020: 40).

Due to its traits, the species might be especially used in coastal regions including Blacksea, Mediterranean and Aegean in Turkey. However, the Mediterranean region may cause some problems because of the high temperature.

It is determined by Suleiman, Rorat, Grobelak, Grosser, Milczarek, Plytycz and Vandenbulcke (2017: 103) that *D. veneta* caused a decrease in heavy metal concentration in soil. Using *D. veneta* in vermicomposting is an effective way of converting sewage sludge to vermicast, however, there are some detrimental effects on worms if they are fed with sewage sludge more than 8 weeks (Rorat et al., 2013). Besides, Boruszko (2020: 22) denoted that some mostly used special earthworms, one of which is *D. veneta*, is a noteworthy application to the decomposition of organic matter, reduction of heavy metal in soil and increasing the soil productivity.

3.3. *Lumbricus rubellus*

Lumbricus rubellus shows optimal growth in the medium in which moisture is high and the temperature is at average 18 °C. So, it can be a felicitous decision that sewage or animal manure should be preferred as substrate material when using *L. rubellus* species in the vermicomposting process. Its maturation time (74-91 days) and life cycle (120-170 days) are relatively long compared to other earthworms used in vermicomposting, and also its growth rate is lower than the other. Although *L. rubellus* has a high tolerance for cold conditions and large size, it can be a false preference using in vermicomposting due to its long-term maturity. So, *L. rubellus* species are more suitable for Eastern Anatolia and high altitude Central Anatolian regions of Turkey. The species is already used in the Turkish market for vermicompost production.

Bakar, Mahmood, Teixeira da Silva, Abdullah and Jamaludin (2011: 1036) revealed that converting the sewage sludge and mushroom wastes into vermicompost by *L. rubellus* is both profitable and productive method, especially in the regions like Malaysia in which 6 million m^3 sewage sludge shows an upper-year in 2015 and is estimated to reach 10 million m^3 in 2020 (Zakaria, Hassan, Faizairi, Petronas and Iskandar, 2015: 24) and more than 5 million tones of mushroom wastes (Hanafi et al., 2018, 1383) are discarded annually. Bakar, Gawi, Mahmood and Abdullah (2014: 1491) stated that various agro-industrial wastes are successfully converted into vermicomposting bt L. rubellus. Moreover, it was revealed that *L. rubellus* has a significant effect on increasing soil microbial activity in the long-term (Heděnec et al., 2020: 103463).

3.4. *Eudrilus eugeniae*

Eudrilus eugeniae is a substantial species, used as both fish bait due to its large morphology and also in vermicomposting because of the high reproduction rate and rapid decomposition of large quantities of any organic matter. So, although *E. eugeniae* is originated from Africa, it has been bred in many other countries, especially in Canada and the USA. However, it is susceptible to

handling and narrow temperature ranges. The optimal temperature preference for maximum biomass of this species changes between 25-30 °C and its growth rate significantly decreases in lower temperatures than 15 °C. So, using *E. eugeniae* is not suitable for vermicomposting in outdoor systems in conditions in which temperatures are not controlled. The most appropriate moisture range is 80-82% to a high growth rate. Its lifespan, life cycle and sexual maturity occupy 1-3 years, 50-70 days and 40-49 days, respectively (Dominguez, Edwards and Ashby, 2001: 341). Dutta, Phukan, Baruah, Safique and Jahan (2016) revealed that high-quality vermicomposting from the waste of tea factories can be successfully produced by *E. eugeniae* in a short time. Therefore, *E. eugeniae* species might be preferred in the Southeastern Anatolia region provided that humidity control is carefully done.

Parmar, Mor and Patel (2019: 1) pointed out that vermicomposting of maize and banana pseudostem wastes by *E. eugeniae* is a unique technique in terms of gaining valuable organic material and repressing the environmental pollution. Joseph and Kathireswari (2020: 186) indicated that leaf litters might be able to convert into added-value material and efficient soil amendment by *E. eugeniae* with vermicompost technology. Varma et al. (2016) researched 3 earthworms, *E.fetida, E.eugeniae* and *P. excavatus*, in terms of growth rate, decomposition of organic matter and accumulation of heavy metal. They determined that the growth rate of *E. fetida* is higher than other species, while the most accumulation of heavy metal during vermicomposting was obtained from *E. eugeniae*.

3.5. *Perionyx excavatus*

Perionyx excavatus is a species mostly found in tropical South Africa, but it has been transferred to Europe and America since its exploration. The high humid and organic wastes are necessary for the optimum growth of *P. excavatus*. It has some advantages including; excessive prolific, easy to handle and harvest, tolerant to low- temperature, and that it can survive up to 4 °C. In addition to low-temperature, it is more tolerant of high temperature over 30 °C. The maturity time of the species is low, however, its fecundity is lower than some other species such as *E. eugeniae*. The species reaches sexual maturity within 20-28 days while its life cycle takes 40-50 days (Karmegam and Daniel, 2009: 4790). It was stated that converting the domestic wastes into vermicompost by P. excavatus can be an efficient and low-input technology (Suthar and Signh, 2008: 5). The use of *P. excavatus* in converting some seaweeds to vermicompost enables to be produced a rich organic material, in which total NPK contents significantly increase (range 26.72–78.17%) compared to seaweed composts (Ananthavalli, Ramadasb, Paula, Selvic and Karmegam, 2019: 394). Also, Parthasarathi, Balamurugan, Prashija, Jayanthi and Basha (2019: 65) indicated that P. excavatus has a noteworthy potential in converting lignocellulosic wastes into high-quality vermicast.

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Chapter 3

THE PRELIMINARY EXAMINATION OF RECREATIONAL POTENTIAL IN MESIR NATURE PARK IN MANISA/TURKEY

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INTRODUCTION

In order to meet the diverse needs of people and improve the quality of life, the use of living and inanimate resources of the biosphere be taken into consideration the social and ecological factors as well as the economic and economic factors (Akten, 2003;Dudek, 2017; Yazici et al., 2017).Both the preservation of natural-cultural resource values and recreational, touristic, scientific, educational etc. nature protection practices are very important roles in natural protection areas (Calik et al., 2013: Akça ve Yazici, 2017; Yazici and Akça, 2017). Within the national borders of the countries, different areas of protection could be determined under the names of national parks, nature protection areas, landscape protection areas, nature parks, natural, archaeological and urban sites, biogenetic reserves, biosphere reserve areas, wetlands and special environmental protection areas Fleishman, and Feitelson,2009; Karadag, 2001). Turkey is a natural bridge between in Europe, Asia and Africa, the diversity of the geological structure is very rich due to be having various climates and ecological richness in biodiversity. However, excessive and misuse of resources for many years and failure to overcome the existing problems were caused a decrease in species. Therefore, identification of conservation areas for Turkey to solve the problems of planning that has been an important issue. With the emergence of the need for organized and global studies for the protection of nature in the world, the İnternational Union for Conservation of Nature (İUCN) established in 1948 and became a global authority on the status of the natural world and the measures to protect it. Today, it is the world's most widespread and diverse environmental network, with the expertise of more than 1300 members, including governments, non-governmental organizations, local community organizations, and support of more than 10,000 international experts. The purpose of the National Parks Law, which was announced in the official newspaper in 1983; According to Republic of Turkey Ministry of Agriculture And Forestry General Directorate of Nature Conservation And National Parks, It was the determination of the necessary principles for the selection, determination, protection, development and management of the national park, nature park, nature monument and nature protection areas that have national and international values. Natural parks that was defined as "nature pieces that have vegetation and wildlife features and are suitable for the rest and entertainment of the people in the integrity of the landscape" in the National Parks Law. According to Republic of Turkey Ministry of Agriculture And Forestry General Directorate of Nature Conservation And National Parks; there were available 243 nature parks in 2018 Nature Parks offer many activities such as protecting, managing, developing and restoring large landscapes as well as improving the recreational opportunities of countries by providing sustainable use of natural resources, promoting tourism development in structurally weak areas, environmental education, special activities for children and youth, recreation, physical exercise, bringing together exploring cultures Protected areas are geographical areas, which are defined and managed through legal or other effective means to ensure long-term protection of nature with

cultural values (Dudley et al. 2013). Besides, one of the protected areas where outdoor recreation activities are intense is Nature Parks (Akça and Yazici, 2017; Akça and Gülgün Aslan, 2019). One of these nature parks was Mesir Nature Park in Manisa Province. The aim of this study; İt was to analyze the current potential of Mesir Nature Park as an important recreation and habitat, as a more effective outdoor recreation area within the conservation and utilization balance, using the recreation potential assessment method developed by Gulez in 1990.Within this potential, the Mesir Natural Park aimed to reveal the principles of carrying capacity, conservation / use and sustainable development, as well as ensuring the development of recreational use values as an active or passive recreation area, as well as ensuring the development of recreational use objectives.

MATERIAL AND METHOD

Mesir Nature Park was the main material of the study. Besides, various publications on the subject of the research, previous studies related to the field of study, information and documents obtained from institutions, notes were taken during on-site examinations and photos taken were among the research material. In this context, in the determination of the recreation potential of Mesir Nature Park, the General Directorate of Nature Conservation and National Parks, the General Directorate of Meteorology and the observations made in the Mesir Nature Park were used. Also, photographs were taken to determine the current situation and for presented suggestions

The study area is within the boundaries of Yunusemre central district of Manisa province. According to Manisa, Yunusemre Municipality,12,03 ha; A nature park was declared on 22.04.2008 (Figure 1;Figure 2; Figure 3).

Figure 1. Location of the research area (URL-5).

Research subject area; It is located at an altitude of 190 m and between 38º60’40.2 “latitude and 27 º38’56.7” longitude. As a method in the study, in order to determine the recreational potential of Mesir Nature Park, the evaluation

developed by Gulez (1990) with the aim of "Determining the Recreational Potential in the Forest" was used. According to Gulez (1990) method recreational area potential (RP); landscape value (P), climate value (İ), accessibility (U), recreative facilities (RF) and negative factors (NF) of the area were determined and detailed scoring of these items. It was performed. Also, Forest Recreation Potential Evaluation Form was used in the method. It was performed according to the Forest Recreation Potential Evaluation Form used in the method. The scores of the Negative Factors data are calculated by a practical mathematical operation as follows (Gulez, 1990).

(Lv + Cv + A + RC – NF = % RP)

Figure 2. Images of Mesire Nature Park (General Directorate of Nature Conservation and National Parks)

Figure 3. Images of Old Mill Bent channel (General Directorate of Nature Conservation and National Parks)

There were certain distributions of the minimum (minimum) and maximum (maximum) points out that the symbols whose weights were indicated in the formula (Table 1). Since the total score will be 100, the sum of the points that can be obtained gives the outdoor recreation potential in percentage form. According to these distributions (Gulez, 1990).The recreation potential of the area was interpreted in the following 5 intervals in line with the sum of the points received in determining the recreation potential. They are **"Very low** (30%>), **low** (30 - 45%), **medium** (46 - 60%), **high** (61 - 75%), **very high** (<75%)".

Table 1. Recreational potential determination elements and scores (Gulez, 1990)

Symbol	Meaning	Maximum Score (Coefficient)
P (Lv)	**Landscape Value** (Size of the area, Topography, Vegetation cover, Open water, Visual quality, Other characteristic)	35
İ (Cv)	**Climate Value** (Temperature, Precipitation, Sunshine, Windiness**)**	25
U (A)	**Accessibility** (İmportance of Tourism of the region in which use area located, İf there is a big city(min. 100.000 populations in region, Travel time, Transport, The other means of access)	20
RK (RC)	**Recreational Convenience** (Picnic facilities, Water supply, Accommodation facilities, Lavatories, Car parks, Refreshment, Wardens, The other facilities)	20
OSE (NF)	**Negative Factors** (Air pollution, State of insecurity, Lake of clearing services, Noise, the other negative factors)	0 (Minimum - 10)
% RP	**Recreational Potential**	**100**

RESULT AND DISCUSSION

In the study conducted based on the data obtained, the recreation potential of Mesire Nature Park was determined within the scope of the following landscape value, climate value, accessibility, recreational facilities and negative factors, together with the method developed by Gulez (1990).

• **(LV): Landscape Values;** *Size of the Area:* According to the General Directorate of Nature Conservation and National Parks, Mesir Nature Park covers an area of 12.03 ha. As stated in the method, Mesir Nature Park was given 4points for the area size because it was larger than 10 ha.*Vegetation cover;* According to the 2013-2023 study of Manisa Province Nature Tourism

Master Plan of the General Directorate of Nature Conservation and National Parks; area was afforested in the form of the arboretum with native plant species, and there are 92 different plant species in this section. Among these species, *Astragalus* sp. (Geven), *Nerium* sp. (Oleander), *Thymus* sp. (Thyme) and *Platanus* sp. (Sycamore), Quercus sp. (Oak), Salix sp. (Willow), Nerium sp. (Oleander), Pinus sp. (Pine), *Populus* sp. (Poplar), *Laurus* sp. (Laurel), *Sequoia* sp. (Redwood), *Pyracantha* sp. (Fire thorn), *Cupressus* sp. (cypress), *Hedera* sp. (Forest ivy), and *Cotoneaster* sp. There were (mountain medlar). In this context, it was determined that the vegetation of the area was wooded, bush and meadow, and the vegetation score was found to be 8. Also in Manisa Mesir Nature Park; Plants such as anise, cuneiform, black cumin, mustard, galanga, black pepper, cumin, coriander, goat mulberry, licorice, daily, orange, fennel, ginger, turmeric, new spring, chewing gum were also grown.*Open Water;*Bozkoy Stream and Kent Forest Pond waterfalls, which create a living environment for many flora and fauna elements, and Mesir Nature Park, which creates a potential for visitor usage, have an important landscape resource value. In this context, the sea, lake, and streams score were found to be 4 points due to its hosting and proximity to Bozkoy Stream.*Topography;*İn the topography condition assessment of Mesir Nature Park, the average slope of the area was found by using the "Google Earth" program land section method. Accordingly, the average slope between the two randomly selected points varies between 0.8-14.3% at 250 meters. According to the slope change classification, the score of the area evaluated as rough is determined as medium rough and 1 point is given.*Visual Quality:*İn terms of archaeological and historical values, 3 hectare area of Mesir Nature Park constitutes a promotional park. This area is arranged to serve the people of Manisa and students of Celal Bayar University. There is a watermill dam in the Mesir Nature Park area. Bozkoy Stream and City Forest Pond waterfalls have a variety of visitor usage profiles in terms of flora and fauna, as well as hosting panoramic views. The display of live and inanimate specimens of plants in the mixture of Mesir paste draws attention to the history of Manisa Mesir Paste. As a result of the analyzes made in the study area, the overall visual aesthetic value of the area received 4 points in terms of visual quality.*Other Features:* Mesir paste, which is widely known among the people today, had a special place because it was one of the strongest drugs of the palace in the Ottoman Empire. In the Mesir Nature Park of the Ministry of Environment and Forestry, it provides the plants used for making Mesir paste to be grown in a certain area. By planting 80 types of plants in the park, it displays the plants used in the production of mesir paste and aims to increase the recreative value of the area. Besides Rabbit, partridge, songbirds, fox, pig, born, hawk, starling, jay are the fauna of the area. The area received 5 points in terms of other features.

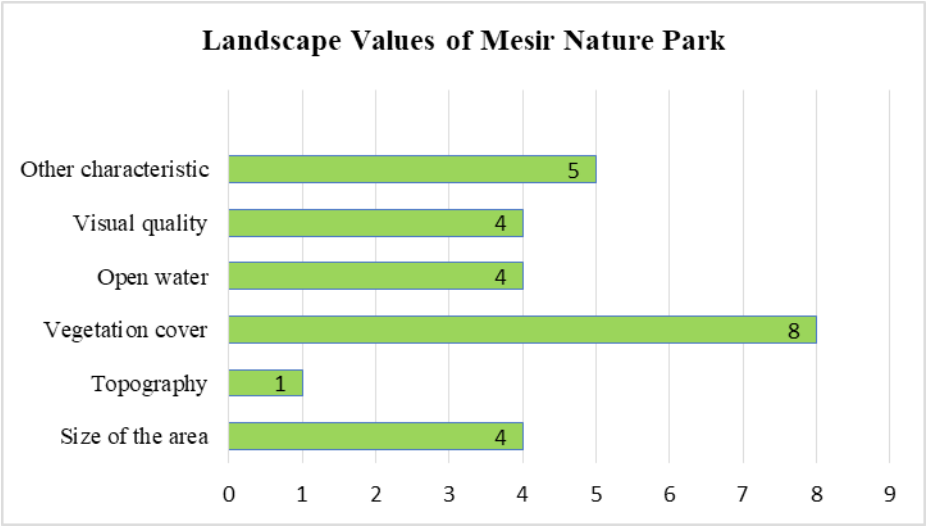


Figure 4. Landscape Values of Mesir Nature Park according to Gulez method

In summary, the score of landscape values was 26 points and points were shown in Figure 4. Altunoz et al (2014) determined that the Landscape value was 30 points in their studies. On the other hand, Ayhan (2019) determined that the landscape value score was 27. If the mesir nature area is developed, the results will be more positive.

• **Climate Value (Cv);** Climate is an important concept that affects the landscape values of an area. For this reason, climate parameters were very important in determining recreation potential. The values included in the calculation in the Gulez (1990) method was based on the months of June, July and August, which cover the summer months when the recreation was most common. The data obtained from the Rasat Portal (2020) and the General Directorate of Meteorology were used to determine the values.*Temperature:*Based on the data between 1930-2019, the average temperature of the summer season of Manisa in June, July and August was found to be 26.8 and the temperature value score was found to be 9 points.*Precipitation:*The amount of precipitation received by open areas could negatively affect the recreative value of the area. For this reason, it was important to know the amount of precipitation received in the summer. Between 1930-2019, the average amount of precipitation in June, July and August was found to be 12.9 and 8 points were given to precipitation. *Sunshine:*Sunshine time was evaluated with cloud average. 5 points were given because the cloudiness average of June, July and August was in the range of 0-2. (URL-1, 2020). *Windiness:*Average summer windfall value of Manisa province was 2.93 m / sec. As it was found1 point to the windy situation (URL-1, 2020).

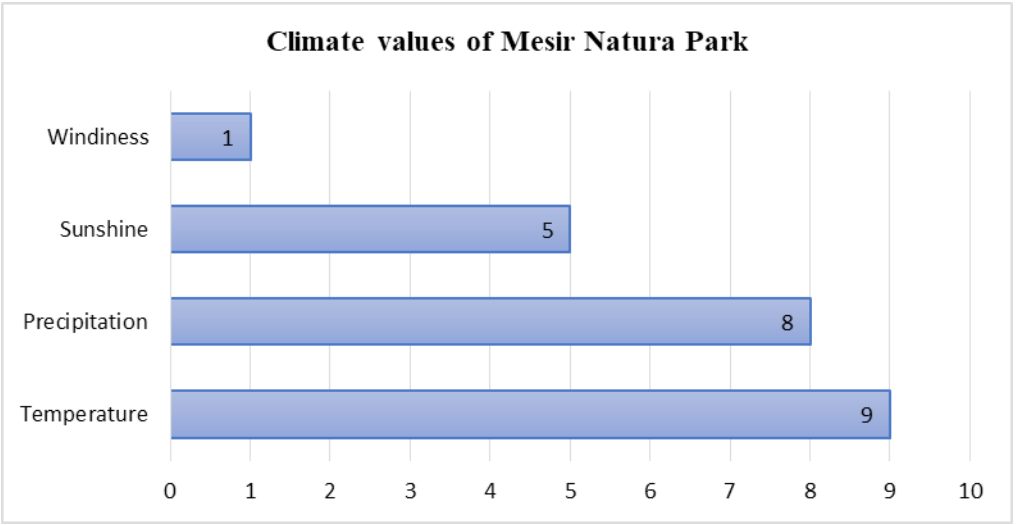


Figure 5. Mesir Nature Park Climate Value according to Gulez Method

When the climate value (Cv) of the area was evaluated in accordance with the points given to the features; İt was determined as 23 (9 + 8 + 5 + 1) points. Climate value table of Manisa province was given in Figure 5. Ayhan (2019) calculated that climate value was 21point. In the study of Birinci et al (2016) The climate value determined as 12 points. According to Cetin et al. (2018); climate value of their study was 13 points.

• **Accessibility (A);** Criteria such as the transportation time of the area, the mode of transportation, whether the population of the region is more than 100.000 are of great importance in terms of recreation value.*Importance of Tourism of the region in which use area located*; The study area was in Uncubozkoy neighborhood in the central district of Yunusemre in Manisa. It was not located near any major road route or tourist area with any coastline. It was adjacent to the city forest with its residential areas.*If there is a big city(min. 100.000 populations in the region;* The distance between Manisa and İzmir was 40 kilometers in the Aegean Region. According to the Turkey Statistical Institute,İzmir province's population was 4,367,251 (TUİK, 2019). In this context, 3 points had given for being a city with a population of at least 100.000 in the region up to 50 km.*Travel time;*In the calculation of this value, the district of Yunusemre which had a population of 15,247 (TUİK, 2019) according to the population criterion of at least 5,000 people, located 55 km from Mesir Nature Park, was taken into consideration. In this context, transportation points were given as 2 points because transportation from the district of Golmarmara can take 1-2 hours by vehicle.*Transport;*Mesir Nature Park was located close to the city center. For this reason, it could be reached from the residential areas close to the site by walking or by private vehicles, and by regular buses of the city buses from the city center Url-3. (2020).

For this reason, 4 points were given to transportation. *The other means of access;* There was not transportation to the area by sea, cable car or a different option. Accessibility (U) value was determined as 9 (3 + 2 + 4) points when calculated according to the points given to the features. (Table 2). Ayhan (2019) determined that accessibility factor was 10 points in their study. Birinci et al (2016) determined that accessibility factor was 9 points. Also, accessibility factor was 13 points in their study of Cetin et al (2018).Yesil and Hacioglu (2018), accessibility factor was 10 points in their study.

Table 2. Mesir Nature Park Accessibility Factor

Factor	Factor properties	Statement	Maximum Point	Point
ACCESSİBİLİTY (A)	İmportance of Tourism of the region in which use area located	Located on the coastline or proximity to the touristic area	4	-
	İf there is a big city(min. 100.000 populations in region	Up to 50 km distance	5	3
	Travel time (at least 5,000 inhabitants nearby)	1-2 hours by vehicle	4	2
	Transportation (except taxi and private car)	Going on foot or finding a vehicle at any time	4	4
	The other opportunities in transportation	Transportation by sea or cable car etc.	3	-
			Total point	9

Recreational Convenience (RC): This was the section where the recreational features such as landscape reinforcement elements that the area offers to its visitors were evaluated. *Picnic facilities:* There was a fixed picnic table and fountain in Mesir Nature Park. There was not hearth in the area. Picnic tables were designed as closed, open and semi-open and it was determined that approximately 3-5 people could easily spend time. 3 points were given since picnic tables in the area were insufficient in terms of quality and insufficient quantity. *Water supply,* according to Manisa Water and Sewerage General Directorate; İt was determined that the water of the area was used as mains water in its region after it was extracted and stored by water drilling. As a result of the analysis carried out by the general directorate, it was determined that the water was not yet suitable for drinking water. For this reason, 2 points were given to the water situation. *Accommodation facilities*; There wasn't possibility to set up an overnight accommodation facility andcamping with or without a tent in the area. *Lavatories*, it was determined that WCs were not sufficient in Mesir Nature Park because the number of visitors to the area is high (public holidays, holidays, etc.), and there was a queue in front of the WC. Despite this, WCs were observed to be clean and 1 point was given in terms of their qualities. *Car*

*parks,*therewas not space reserved for parking in the entrance and surrounding areas. It was observed that the visitors parked their vehicles randomly around the area. No points were given due to the lack of parking space, determination of vehicle locations, and uncertain parking capacity.*Country Casino, Sales Buffet:* There was a country casino near the entrance of the area, and there was not sales buffet. For this reason, 1 point was given. *Guard and Officers:* There was also a permanent officer in the park, the area was kept under constant observation. For this reason, 2 points were given to the presence of a guard and a guard. *The other facilities*there was is a children's playground and a walking track in this area. 1 point was awarded due to the lack of different facilities in accordance with the characteristics of the playground and sports field facilities and the area. When the recreative value (RK) was evaluated according to the points given to the features, it was determined as 10 (3 + 2 + 1 + 1 + 2 + 1) points (Table 3). Yesil and Hacioglu (2018) determined that recreational convenience factors were 10 points in their study. According to Calik et al (2014) recreational convenience factors was 24 point. Birinci et al (2016) reported that it is important to contribute to the recreational potential of the natural park and its surroundings in order to increase the recreational potential, many sports activities such as photo-safari, which provide camping and caravan tourism in the summer (Table 3).

Table 3 Mesir Nature Park Recreational Convenience Factors

Factor	Factor properties	Statement	Maximum Point	Point
RECREATİONAL CONVENİENCE (Rc):	Picnic facilities	Fixed picnic table, stove, etc.	4	3
	Water supply	Drinking and using water facilities (according to their qualifications	3	2
	Accommodation facilities;	Fixed overnight facility, the possibility of camping with or without a tent	2	-
	Lavatories	According to the qualifications	2	1
	Car parks	According to the qualifications	2	-
	Country Casino, Sales Buffet:	According to the qualifications	2	1
	Guard and Officers	Continuous - guard / officer on weekends	2	2
	The other facilities	Playgrounds and sports fields facilities, facilities etc	3	1
			Total point	10

• **Negative Factors (NF);** As a result of observational studies in the field; The area has been evaluated from negative aspects such as air pollution, safety, negligence and noise. Because it was close to the mountain, it was far from air pollution, it was a rural casino operated by the district municipality, and its safety has been provided continuously, and no negative situation was encountered due to the lack of music application in high or low sound for any reason. However, due to intensive use in the area, partial neglect was detected in vegetative

landscaping areas and water areas. For this reason, (-1) points were given to neglect and water pollution values. When the value ofnegative factors (NF) was evaluated according to the points given to the features, it was determined as (-1) + (-1) = -2 points (Table 4).In the study of Birinci el al (2016) determined that negative factor was 0 point.In the study using the method of Gulez (1990) to determine the recreation potential of the Nature Park, Landscape Value (Lv) 26, Climate Value (Cv) 23, Accessibility (A) 9, Recreational Facilities (RF) 10 and Negative Factors (NF) -1 point and the recreation potential was calculated as %67 in line with their totals.

Table 4. Mesir Nature Park Negative Factors

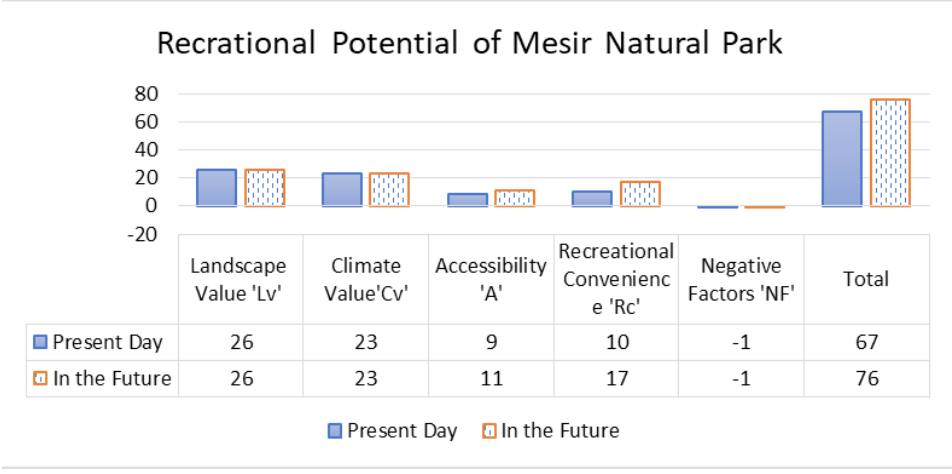
Factor	Factor properties	Statement	Maximum Point	Point
NEGATİVE FACTORS (NF)	Air pollution	According to the degree of pollution	(-1)-(-3)	-
	İnsecurity	By assurance status	(-1)-(-2)	-
	Water pollution	For sea, lake and streams	-1	-
	Neglect	İnsufficient maintenance in the area	-1	-1
	Noise	Traffic, noise, crowd etc.	-1	-
	Other negative factors	İt is close to the quarry, etc.	(-1)-(-2)	-
			Total point	-1

Yilmaz et al. (2018) The recreational value of Artvin City Forest was determined. As a result of the study, it was found that the area has a high potential with 66.9% in terms of recreational potential. The recreational potentials were respectively Altinoz et al (2014) 68 point, Ayhan (2019) 69 points, Birinci et al (2016) 59 points, Yazici ve Asur (2018) reported that the values of Kaz Lake recreation potential were 65 points. Yazici ve Akça (2019) The recreational value of Boraboy Lake was determined. The parameters reviewed in Boraboy Lake did not yield a negative point. Upon examination in terms of recreational aspects; it is seen that the highest points (49 points) is set for the country houses for the lodgers. The location for the use of day trippers has (43 points) and tent camp area has (36 points). The lake factor which is used in evaluating the water existence, also has a high point of (47 points). According to the criteria of determining the recreation potential of the method, the study area has a “high” recreation potential as specified in the “61-75%” range.

CONCLUSION

Mesir Nature Park was located within the boundaries of the city center and offers a high utilization opportunity, and its recreational potential was determined as “high” with 67%.While examining the natural values that cannot be changed in the study area such as landscape value and climate value; On the other hand, modifiable factors such as accessibility, recreational convenience and negative factors were also taken into consideration. For this reason, the recreation potential of Mesir Nature Park; could co be developed with studies to increase recreational facilities and reduce negative factors. In the evaluation form of

Gulez (1990), the total score of recreational facilities was determined as 20, and the total of the recreational facilities of Mesir Nature Park was determined as 10 points. The reason for this was that there was no need for overnight facility / camping facilities with or without tents, no parking area and sales kiosk, partial water condition, improvement of the quality and quantity of WCs, and the establishment of new playgrounds and sports facilities. It was recommended that an overnight facility in harmony with the natural environment, a space for camping with tents and tents, and sports areas should be established with the design and implementation of a parking area in a capacity suitable for the annual number of visitors without interfering with the topography and ecosystem of the park. Increasing the number of water closets and establishing a sales buffet were among the suggestions. Increasing and improving these opportunities in the Natural Park will increase the recreation potential by 6 points. When the negative factors in the field were evaluated in accordance with the points given to the features, it was determined as -1 point due to neglect. design area of flowers according to seasonal changes of vegetative landscape application areas in the area and increasing the maintenance works such as pruning, mowing, spraying, and fertilizing the existing green tissue could eliminate the existing neglected image.It will also increase the recreation potential by regularly cleaning the area in the work area and replacing the old reinforcement elements with new ones. Thus, the recreation potential could be increased by 1 point. In line with the improvements in the field, the existing recreation potential could be increased to 74 percent (Figure 6).



	Landscape Value 'Lv'	Climate Value'Cv'	Accessibility 'A'	Recreational Convenience 'Rc'	Negative Factors 'NF'	Total
Present Day	26	23	9	10	-1	67
In the Future	26	23	11	17	-1	76

Figure 6. Total of recreational potential of Mesir Natural Park

According to the existing potential of Mesir Nature Park, eco-tourism activities such as botanical tourism, trekking, photo safari, bicycle safari, bird / butterfly cruise were proposed. It is stated that these proposed activities could be used as a means for the sustainable use of protection and landscape values. In addition, ecotourism activities and tourism activities in the area will be diversified and it will be possible to use the area not only in summer but throughout the year.

The reason that Mesir Nature Park is the main source of value for recreation and tourism activities is not only because it has a recreational potential but also primarily a protected area with vegetation and wildlife in this area. The issue that should be taken into consideration in recreation planning here was to ensure the resource conservation of the area and the sustainability of the riches in the area while providing outdoor recreation potential.

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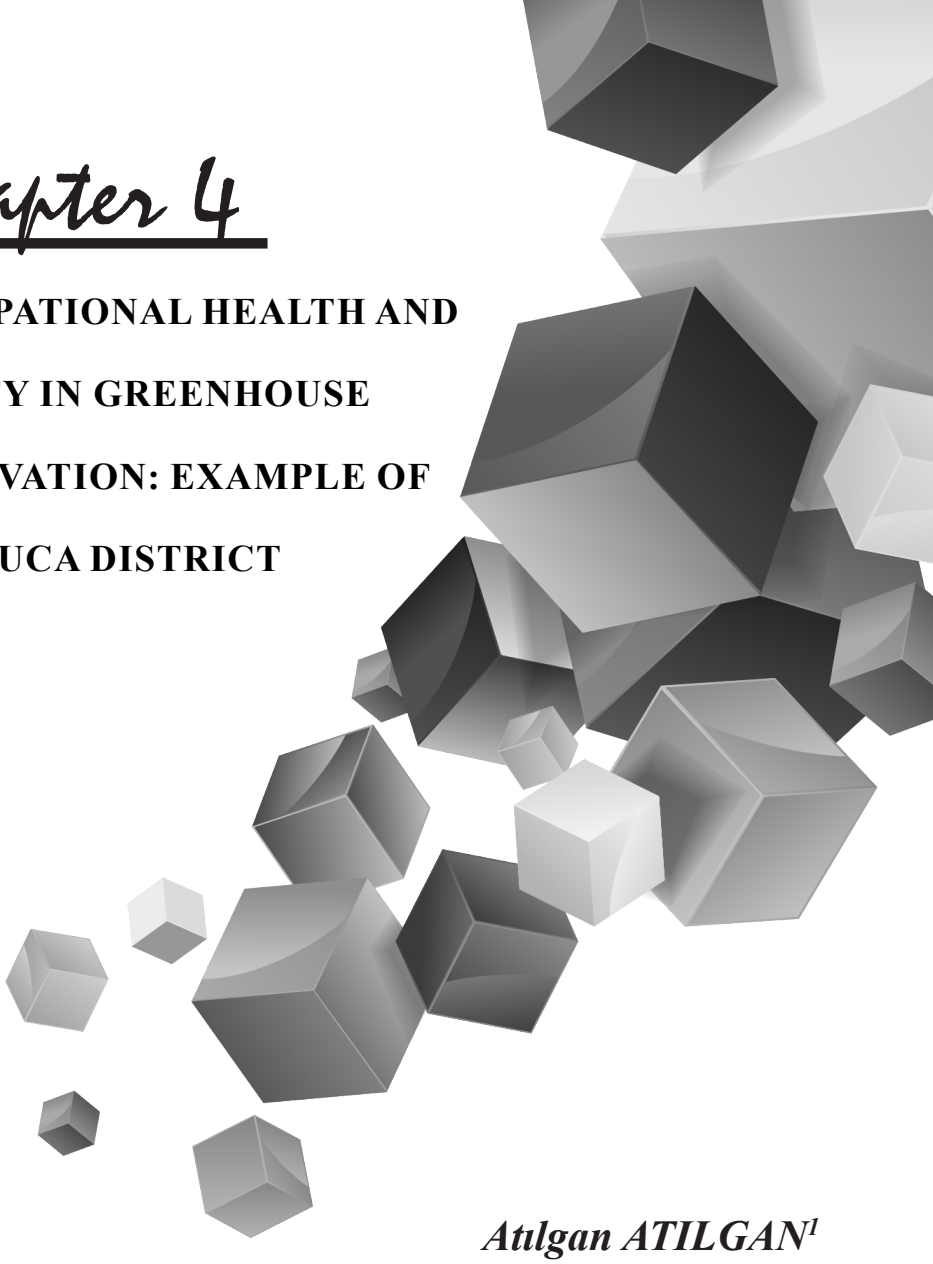
Chapter 4

OCCUPATIONAL HEALTH AND SAFETY IN GREENHOUSE CULTIVATION: EXAMPLE OF KUMLUCA DISTRICT



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INTRODUCTION

Agriculture is a sphere that works with living material in nature and is directly affected by natural conditions such as climate and soil structure. The agricultural sector, which differs from other sectors, is mainly active in the open air and manpower. In the agricultural sector, which differs from other sectors, activities are mainly carried out outdoors and with manpower. Agricultural work is the work done with a wide variety of machinery, animals, plants and other products in very wide areas, under everchanging climate and geographic conditions (Yalçın et al., 2016).

Greenhouses are vegetative production structures where unfavorable climatic and topographic conditions can be controlled and supervisioned by human intervention. The increase in the consumption of vegetable and animal products due to the world population rate has made it necessary to find new agricultural techniques and production areas. It is predicted that the importancy of greenhouse production will increase even more in the next century, and interest in this sector will increase due to both climatic changes and the demand for excess production. Increasing interest will also bring various negative occupational accidents (Saltuk and Atılgan, 2020).

Laborers working in the agricultural sector take part in all stages of the product, including seeding, planting, cultivation, harvesting and packaging. When we look at the share of workers in production due to their high employment potential in the agricultural sector, the invisibility of their labor versus the labor force, and the high level of informality in the sector, the difference is striking. In the agricultural sector, albeit high physical performance and long working hours, wages, health, transportation, accommodation, education and social problems are seen very intensely (Çamurcu and Seyhan, 2015).

Agricultural activities can bring various health problems. Workers engaged in agricultural activity face significant risks for cancer, respiratory diseases, injuries and accidents. The fact that agricultural lands are generally far from the center brings difficulties in accessing emergency health services. The working environment of agricultural workers includes physical hazards arising from air, land, fire and machinery, toxicological hazards arising from pesticides, fertilizers and fuel, as well as dangers from dusts (Ahioğlu, 2008).

In many studies carried out by the researchers, the dangers that can be encountered by the workers in the agricultural sector and the measures that can be taken are investigated, and it is aimed to convey the information obtained about the prevention of occupational accidents in agriculture to those who concerned. Researchers reported that nearly half of the world's population works in agriculture and a significant portion of occupational accidents occur in the agricultural sector (Güğercin et al., 2018).

According to ILO data, 170,000 people die each year in the agricultural sector, which employs 1.3 billion people, many workers encounter various occupational accidents and are exposed to occupational diseases. According to the European Union Statistics Office (EUROSTAT), the agriculture sector is considered as the second most dangerous sector after the construction sector (Çamurcu and Seyhan, 2015).

This study was carried out in order to determine the causes of occupational accidents that occur during production in greenhouses, their possible impact on employees and to draw attention to the importance of occupational health and safety

MATERIALS AND METHODS

The study was carried out in Antalya province Kumluca district and its neighborhoods. Kumluca district is located in the Mediterranean Region, between the Gulf of Antalya and the Gulf of Fethiye, on the outcrop that extends towards the Mediterranean, called the Teke Peninsula. Kumluca, one of the districts in the west of Antalya province, is 95 km away from the center. The district is surrounded by the Mediterranean from the south, Kemer from the east, Korkuteli from the north, Central district from the northwest, Elmalı and Finike from the west (Figure2). Kumluca district center is one of the most extreme points in the south of our country, since it is located between 36º 23´ North latitude and 30º 18´ east longitudes (Anonymous, 2020a).

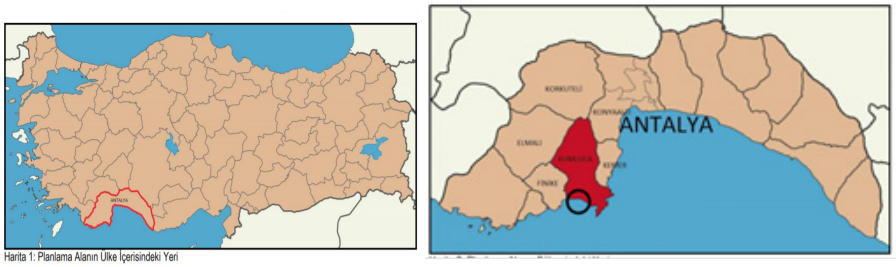


Figure 2. Study Area Map Antalya Kumluca (Anonymous, 2020b).

The research is constituted by the enterprises in the district of Kumluca, where greenhouse cultivation is carried out most intensively in Antalya province. Although the greenhouse cultivation in the region is intense, the agricultural techniques applied are at a repetitive level. Therefore, Simple Random Sampling Method was used to determine the number of sample businesses to be surveyed. The number of samples was calculated with the help of the equation stated below (Çiçek and Erkan, 1996) The sample volume was determined as 97 as a result of using Equation 1.

$$n = \frac{N \times S^2 \times t^2}{(N-1) \times d^2 + (S^2 \times t^2)}$$

In this formula:

n: Sample size (97 enterprises);

S: Standard deviation (5.058);

t: t table value corresponding to the confidence limit (1.65 for 90% confidence interval);

d: Acceptable error margin (arithmetic mean * error margin = 6.58 * 0.10 = 0.658);

N: the total number of units belonging to the sampling frame.

In the present study, Occupational Health and Safety practices applied in greenhouse cultivation were examined, and 5x5 L type Analysis Matrix was applied by referring to the opinions of employees and workplace stakeholders. While creating the matrix, the experiences of the workplace stakeholders were taken into consideration. The health problems of the people who work and also have worked before in the greenhouses, its effects of these problems on human life were determined with the help of surveys and a proactive approach was displayed against possible dangers. In case of an accident, reactive measures have been considered and planned in order to quickly resolve any problems that may arise.

Matrix diagrams are an evaluation tool for analyzing the relationship between two or more variables. The 5 x 5 matrix scheme (L type matrix) is used specifically to evaluate cause-effect relationships. This method is ideal for analysts who need to analyze risk, but it is not sufficient for all studies that involve different processes or have very different flow patterns, and the method success rate varies depending on the analyst's background. It should be used to identify hazards that require immediate action in such enterprises. Firstly, in this method, the evaluation and measurement of the result is done at the discretion of the event (Özkılıç, 2005). Hence, expert opinion was referenced in order to get the necessary answers regarding the content validity of the questionnaire. In this context, pre-test was conducted with Agricultural Engineer Celal Münir ŞAHİN, who has an Agricultural Pesticide Dealership in Kumluca district and specialized in greenhouse cultivation, and the questionnaire questions and answers were tried to be determined by discussion. The questionnaires for the study consist of 5 parts. These are, respectively,

A) Information about the business,

B) Information on structures,

C) Agricultural Pest Control and possible effects

D) Environmental effects and

E) The parts where the risks that may cause death or loss of limbs arising from the use of agricultural machinery are questioned.

Risk score must be determined in order to remark the results of the study. According to this; **Risk Score = Likelihood x Degree of Damage.**

For example, the drinking of an idle pesticide in the greenhouse by a child is intolerable, and the risk score resulting poisoning is equal to 25( ). The situation where one or more components can occur at the same time is taken into account to make the rating. With reference to this, a pesticide that left out haphazardly without taking any precautions or an unlocked building, additionally carelessness of the responsible persons increases the probability, accordingly, the violence that may arise increments, and the risk score can be found with the multiplier effect.

Table 1. Risk Score (Rating) Matrix (L Type Matrix) (Özkılıç, 2005)

	Violence				
Possibility	1 (Very Light)	2 (Light)	3 (Moderate)	4 (Serious)	5 (Very serious)
1 (Very Low)	Pointless 1	Low 2	Low 3	Low 4	Low 5
2 (Low)	Low 2	Low 4	Low 6	Medium 8	Medium 10
3 (Medium)	Low 3	Low 6	Medium 9	Medium 12	High 15
4 (High)	Low 4	Medium 8	Medium 12	High 16	High 20
5 (Very High)	Low 5	Medium 10	High 15	High 20	Intolerable 25

The outputs of the study were obtained from the survey data taken in the online system. In the preparation of the study, the opinions of both the practitioners and the online producers were presented as direct results in Google surveys. But in the interpretation of the results, evaluation was made based on the acceptability values (Table 2).

Table 2. Acceptability Values of the Result (Özkılıç, 2005)

RESULT	ACTIVITY
Unbearable Risks (25)	Work should not be started until the determined risk is reduced to an acceptable level, if there is an ongoing activity, it should be stopped immediately. If it is not possible to reduce the risk despite the activities carried out, the activity should be blocked.

Important Risks (15,16,20)	Work should not be started until the identified risk is reduced, if there is an ongoing activity, it should be stopped immediately. If the risk is related to the continuation of the work, urgent measures should be taken and as a result of these measures, it should be decided whether or not to continue the activity.
Moderate Risks (8,9,10,12)	Actions should be initiated to reduce the identified risks. Risk reduction measures can take time.
Bearable Risks (2,3,4,5,6)	Additional control processes may not be needed to eliminate identified risks. However, existing controls should be maintained and its continuation must be supervised.
Insignificant Risks (1)	It may not be necessary to plan control processes and keep records of activities to be performed to eliminate identified risks.

RESULTS AND DISCUSSION

Intensive spraying, especially used in greenhouse cultivation, reveals pesticide exposure. Exposure patterns emerge involuntarily or willingly, from the unconscious approach of children in order to have fun. The study focused on the probabilities of exposure. Especially in the questionnaire section, which consists of 5 parts, the density consists of the results of pesticide-induced poisoning and the use of agricultural vehicles. In the 14th, 15th, 16th and 19th questions of our questionnaire, it was aimed to learn the pesticide use cases, and in greenhouse, in spring - April - June (90.7%) (Figure 3) there is an intensive use, especially it has been declared that the Agricultural Pest Control frequency are done once a week or more by 92.8 percent in this months. Based on these statements, frequent visits to health institutions during these months may show that pesticides have an indirect effect on diseases (Figure 4).

Figure 3. Distribution of Agricultural Pest Control by Months

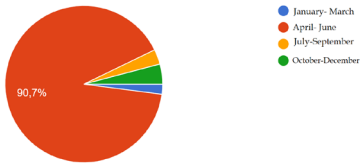
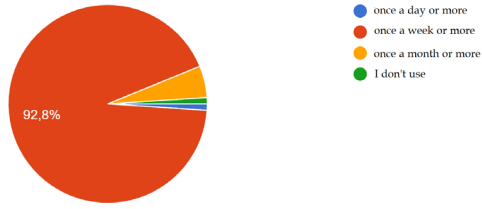


Figure 4. Agricultural Pest Control Frequency



The method of application of pesticides (99%) is manual user application, and exposure to pesticides occurs most at this stage (Figure 5). According to local examinations and expert opinions, oral route is the most common in terms of contact and frequency. This is followed by the skin, eyes and respiratory tract. Producers have been sensitive about the use of protective equipment in

Agricultural Pest Control, declaring that they these equipments at a rate of 95.8%, and even the remaining 4.2% is considered to be quite risky in terms of occupational health and safety (Figure 6).

Figure 5. Application forms of agricultural pesticides

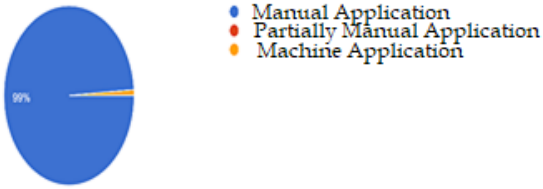
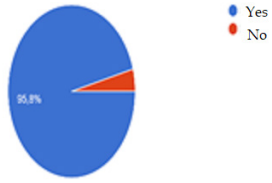


Figure 6. Protective equipment usage situation in agricultural pest control



Swiss physician Paracelsus (1493-1541) made a toxicological definition for the first time by saying that "All substances are poisons. There is no substance that is not toxic. What separates the poison and the drug from each other is its dose" (Saygı, 2015). According to the survey data, 92.8% of the producers reported that they used insecticides in the use of pesticides. Even though the producers of insecticides generally declare that they take protective measures, there are applications to 1 or more health institutions that are thought to have pesticide effects during the year. It has been stated that these treatments are in the form of short-term outpatient treatment. Acute toxicity is the possible health effect as the inevitable consequence of a short time/momentary contact with a pesticide. The only way to prevent this is to encourage the use of protective equipment and machine-based applications. In terms of occupational health and safety, the implementation should be achieved by carrying out the existing controls, taking into account the planned measure and the planned risk value (Table 3). In terms of environmental health and protection of natural balance, in the fight against pests, priority should be given to biotechnical methods and Cultural Pest Control, avoiding chemical spraying (Kaplan, 2019a).

Table 3. Risk table and measures related to the use of pesticides

ACTIVITY	RISK	HARM	CURRENT RISK DEGREE			DEFINITION OF RISK	PRIORITY	CURRENT CONTROL	PLANNED MEASURE	PLANNED DATE	PLANNED RISK DEG-REE			DEFINITION OF RISK
			PROBABILITY	SEVERITY	RISK						PROBABILITY	SEVERITY	RISK	
Use of pesticides and other chemicals	Skin exposure	Allergic Reactions, Cancer, Death	3	4	12	Notable Risk	1	PPE usage is monitored	Regular PPE Controls of employees, preparation of instructions on pesticide use	IMMEDIATELY	1	4	4	Acceptable Risk
	Airborne Particles	Respiratory Difficulty, Diarrhea, Vomiting, Cancer, Death	3	4	12	Notable Risk	1	Employees and Ventilation Are Regularly Controlled	Checking the ventilation regularly	IMMEDIATELY	1	4	4	Acceptable Risk

The effectiveness and usage instructions of the protective materials used are not known by the manufacturer. 46.6% of the producers participating in the survey stated that they do not know the usage characteristics of the materials. Since pesticides are toxic to humans in certain amounts, that is, they are poisonous, people dealing with agricultural pest control must avoid potential damages during its use. Poisoning can occur if people are exposed to pesticides. Accidental oral consumption of pesticides into the circulatory system is often the result of them being emptied from their original containers into unlabeled containers or food containers. Unfortunately, in such situations, children often come across as victims. Therefore, pesticides should be stored in their original boxes. It must be ensured that its label is attached. Plastic pipes used when pouring the pesticide into another container should never be sucked in from the mouth to allow flow while the pipe is in the chemical. After using pesticides, if possible, the whole body, but at least the hands and face should be thoroughly washed with soapy water, then its is allowed to eat a meal or drink water. In order to prevent these poisonings, training on occupational health and safety must be taken and pesticides must be stored in a closed place out of the reach of children. In the survey study, it was stated that there was a pesticide-induced damage, but with short-term treatment results. 97.9% of the producers stated that they store the pesticides they use for agricultural pest control in the warehouse (Figure

7). The answers given to the question of "what do you do with the materials used in agricultural pest control?" are that 92.8% throw it to the municipality garbage bins, 2.1% make a package and bury it in the ground so that it does not affect living life, 1% do not pay attention, and the remaining 4.1% stated that they burn and destroy it. In case of uncontrolled pesticide application, producers are exposed to a large extent of these pesticides by inhalation, skin and contact. Protective masks and gloves should be worn against these chemical pesticides. To provide a minimum of protection, long-sleeved shirts, long-leg trousers and well-fitting boots should be worn. For a much better protection, full body covering protectors, a waterproof hat and rubber boots should be used. In conjuction with this, a waterproof raincoat will block skin contact ways while chemicals are mixed, poured into sprayers or tubes. In the part of the questionnaire about the Awareness of the Harm/Effect of Poisoning Due to Pesticides, 93.8% of the producers declared that they have information on this issue (Figure 8). Awareness on this issue is considered very important in terms of occupational health and safety.

Figure 7. Storage status of pesticides

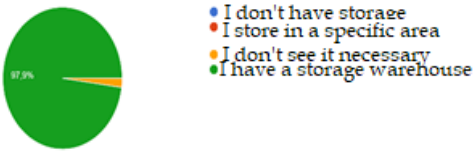
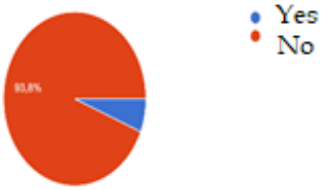


Figure 8. Awareness of harm/impact of pesticide-related poisoning



While 83.5% of the manufacturers declare that excessive pesticide use will harm the environment and human health, 16.5% claim otherwise. The correct understanding of the occupational safety control mechanism will prevent damages as well as allow jobs and transactions to be carried out in a shorter and more accurate time. Accordingly, after chemical control, producers should definitely wash their whole body but if the conditions are limited, they should wash their hands and face thoroughly with soapy water and then continue their activities. With the increase in the use of random pesticides in the fight against harmful organism species in orchards, living beings will cause the existing natural balance to deteriorate, which will increase the possibility of harmfull pests to cause epidemics in the future.

For this reason, all factors should be considered together with their environment while controlling pest species, and it is recommended to avoid broad-spectrum chemical and unnecessary pesticides in the apllied control methods (Kaplan, 2019b).

Pesticides remaining on the soil surface after soil and plant applications can reach the ground water and other water resources in the form of surface runoff with rain water or by movement within the soil. Depending on the slope, vegetation, formulation, soil type and amount of rainfall, pesticides that pass to runoff cause the death of fish and other living creatures in the water. Moreover, by mixing into drinking water, they pose a danger to humans. In the study, 95.9% of the enterprises stated that their greenhouse is located by a water source that is 10m-50m away, and they reported that they do not hesitate using this source. They stated that they used 74.2% from the well in the land, 22.7% from the stream, river and brook, 2.1% from the irrigation canal and 1% from the mains water in the supply of irrigation water. It has been reported that 96% of the producers do not have irrigation and drinking water controls. 52.6% of these producers do not see the need for this, and 46.4% suppose that it will not not constitute a loss. 98.9% of the producers stated that they took measures such as bathing after spraying, changing their work clothes and consuming yoghurt. The indiscriminate release of pesticides to the outside environment has an impact on environmental health, and it can be said that the producers agree on the damage, but the environmental effects on agricultural areas are ignored. In other words, it is thought that the producers' environmental consciousness is not developed or they are negligent.

According to this study, it was also questioned whether the producers had an idea about the possible damages of pesticides to the environment, and 87.5% of the respondents stated that they are like-minded that pesticides pass into the air, water and soil, and from here to other organisms living in these environments and are transformed. In addition, they agree that pesticides may adversely affect human and environmental health in other factors such as formulation type, application method, climate and agricultural conditions, depending on the production site and usage conditions (Figure 9).

Figure 9. Questioning the possible effects on agricultural areas (Producer Environmental Awareness)

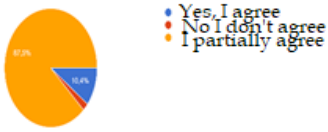
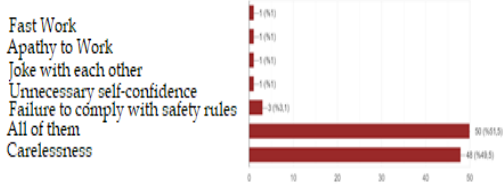


Figure 10. Causes of accidents due to the use of agricultural machinery



Carelessness was the leading cause of accidents due to the use of agricultural machinery with 49.5% (Figure 10). There are economic reasons as well as humanitarian reasons to make agricultural production a safer and healthier workplace. Accidents cause loss of 1- money (cost), 2- resources. These losses

occur in the form of loss of income, loss of production, damage, health expenses due to injury and disability (Saltuk and Atılgan, 2020). Likewise, the resources allocated to prevent accidents should be as little as possible. Therefore, safety rules must be observed in order to reduce accidents. Since greenhouse cultivation is in a continuous cycle in plant production, production activities are a process that continues from the seed stage to the end of the harvest. Hence, production takes place 24 hours a day. In the early hours of the day, especially when the weather is very cold, the greenhouse is heated to protect the products from frost. Since the heating systems are controlled manually, producers also stay awake during this process. Employees cannot make up for the sleep deprivation during the day and continue to work. According to the results of the study, 90% of the producers in the region stated that they encountered this situation psychologically several times during the year and were affected by this (Şahin, 2020).

This condition, which is called as mood disorder in medical language, is especially to be in an inappropriate or exaggerated affect on the main problem conditions and situation. The emotional state shifting towards unhappiness, sadness, and grief can cause depression as well as negatively affect occupational health and safety issues that need attention. The sleep-wake period is called the circadian rhythm and is a combination of two Latin words meaning circa (about) and dies (day). It is known that a regular sleep adjusts the body rhythm and strengthens the immune system (Dijk and Czeisler 1994). The sleep and wakefulness cycle is very important for humans, as regular sleep at night is necessary for the next day's work. Especially in employees working in factories on a 24-hour basis, the beginning of discomfort appears as possible consequences. There are studies on sleep disorders that affect the immune system, lead to cardiac coronary system diseases, and negatively affects the nervous system (Yücel, 2007, Mullington et al., 2009, Scheer et al., 2009, Faraut et al., 2012, Özdemir et al., 2018, Anonymous, 2020)

In our country, accidents with tractor are more common than other agricultural machines. Tractor accidents usually occur as falling from the tractor, the tractor rearing up, tilting and colliding with other vehicles. According to the survey data, 95.9% of the producers stated that they had not received any training on occupational health and safety before. Considering that 48.5% of the producers' education status is primary education, 46.4% is high school, 5.2% is university and 1% is master's degree, the result that there is no awareness of the measures to be taken regarding construction equipment comes out.

Hereby, as a result of the evaluations made in terms of occupational health and safety, the damages caused by especially the use of excessive amount of pesticides and disobeying safety rules and careless use of agricultural machinery, were evaluated, and it was concluded that employees and families should be trained on occupational health and safety.

It is a fact that other researchers agree on this issue. For example, according to Özkaya (2015), the current picture in agricultural employment is indeed complex. Due to the seasonal nature of jobs in the agricultural sector, it has led to the appearance of a concept called mobile and temporary worker. As a result, employees in the agricultural sector have started to suffer from wages, health, education, accommodation and social problems. Of course, one of the most important problems is the registration of employees. Only 1.2 million of an average of 6 million agricultural workers are covered by insurance. Therefore, keeping records of agricultural workers and their determination that these workers and their families should be trained on occupational health and safety issues in order to improve their quality of life in all aspects confirm our work. Especially during the use of pesticides by agricultural workers working in greenhouses, not complying with the instructions and warning signs written on the box, lack or absence of protective safety materials or not being used properly is seen as the main problem. In addition, the absence of mandatory warning signs on occupational health and safety is also a striking defect. The main problem arising from Agricultural Machinery is that agricultural tools and machines are seen as passenger transport vehicles. The news that we frequently encounter in the press, that there are people killed and injured as a result of the overturning of the tractor, reveal the painful result of the incident (Anonymous, 2020c). In addition, possible damages that increase the dangers, especially in greenhouse cultivation, are summarized in Table 5. Being very sensitive about occupational health and safety will prevent many negativities as well as reduce financial losses. The causes and sources of danger given in Table 5 can be prevented by creating a completely controlled production environment. Considering the opposite of the negative sentences stated in Table 5, we also list the necessary measures to be taken against possible accidents.

Table 5. Reasons that increase hazards in greenhouse operations and hazard sources

Reason	REASONS THAT INCREASE HAZARDS, SOURCES OF HAZARDS
1	Dangerous work and unsafe environment,
2	Age and Gender, Negativities arising from family organization,
3	Lack of education, knowledge and experience,
4	Fast work, negligence, joking, overconfidence, not subjecting employees to rotation
5	Disobedience of following instructions and warning signs. No protective safety material or use,
6	Laxness, carelessness, anger, rush, working hours and periods,
7	The attitude of the managers, not following the orders given. Lack of new and secure information system,
8	Using tools and machines in a dangerous way,
9	Insufficient ventilation, heating, lighting,
10	Using old, broken machinery and equipment,
11	Lack of job descriptions,
12	Openness of working area to natural disasters,

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Chapter 5

THE PATTERNS OF TREE DIAMETER DISTRIBUTIONS IN MANAGED ORIENTAL BEECH (*FAGUS ORIENTALIS* LIPSKY) FORESTS

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INTRODUCTION

Forest structure plays an essential role in ecosystem management. The complexity of forest structure may influence biological diversity in forest ecosystems (Gardner et al., 2009). In addition, diversity of ecosystem services may vary depending on the forest structural complexity (Rutten et al., 2015). Tree species composition, distribution of trees and other vegetation are commonly used to define forest structures (Podlaski et al., 2019). Forest structure can be described by vertical structure, which usually refers to canopy tiers between surface and upper canopy, and horizontal structure, which commonly refers to tree diameter size as well as spatial distribution of the trees (Davis and Johnson, 1987). While one distinct age and size class is typical in even-aged forests, there are at least three age classes in uneven-aged forests (Puettmann et al., 2009).

Growth of trees as well as understory seedlings and saplings are influenced by the structural complexity of the forests where they exist. For this reason, it is vital to determine the forest structural complexity for better management of forests. The structural complexity has been commonly determined using tree diameter distribution (Uuttera and Maltamo, 1995). It can even be used to define the vertical stand structure in stands of shade-tolerant tree species (von Oheimb et al., 2005).

Oriental beech tree (*Fagus orientalis* Lipsky) is one of the native tree species of Turkey (Odabaşı et al., 2004). Forests of this species have been mostly managed for its high quality timber in the country. These forests also represent rich biodiversity (Atik, 2013). Northern Turkey is included within the natural range of Oriental beech tree (Czecozott, 1932). Oriental beech covers approximately two-million-hectare area in Turkey (General Directorate of Forestry, 2014). This is about the 9% of the total forested are of the country (General Directorate of Forestry, 2014). The species can be found from the sea level up to 2100 m (Papageorgiou, 2008). Oriental beech can form both pure and mixed stands in Turkey. Although the beech forests have been exposed to forest destruction by humans during the history, current beech forests in Turkey are mostly considered near-natural and semi-natural (Atici & Colak, 2008). Moreover, it was even stated that some virgin beech forests can be also found in northern Turkey as well (Colak et al., 2003).

Oriental beech is a shade-tolerant tree species (Odabaşı et al., 2004. The tree species mostly represents better growth performance on northern slopes in Turkey (Ertekin et al., 2015). Oriental beech stands can be commonly managed under even-aged silvicultural methods such as shelter-wood across its natural distribution areas (Odabaşı et al., 2004; Akbenar and Keshavarz, 2005). Due to its tolerance to shade, Oriental beech can develop, survive and grow under shady conditions (Akbenar & Keshavarz, 2005). However, its establishment into middle and overstory is usually associated with overstory canopy structure (Keivan et al., 2011). Therefore, the structural complexity plays a crucial role for the establishment of Oriental beech forests.

Given the importance of forest structural complexity on tree growth and species diversity (Waltz et al., 2003), forests managers and landowners have been interested in determining the structural complexity of their forests. The diameter size distribution can be used to define the structural complexity. To our knowledge, there has not been any scientific study to define and quantify the patterns of tree diameter distributions in the managed Oriental beech forests in northern Turkey.

In this chapter, it was aimed to represent the patterns of tree diameter distributions in managed Oriental beech forests in northern Turkey. Given the species wide distribution and tolerance to shade, it was hypothesized that there can be different diameter distribution patterns within the managed Oriental beech forests in the country. The assessment of these patterns can help forest managers to develop better management approaches that aims to enhance the structural complexity within the Oriental beech forests in Turkey.

MATERIALS and METHODS

Study Area

The study was conducted in İnebolu district, the north of Kastamonu city, northern Turkey (Figure 1). The Oriental beech forests in this region have been primarily managed for wood production using even-aged silvicultural systems such as shelter-wood method. In İnebolu area, the average total annual precipitation is 952 mm (Climate data, 2020). The average annual temperature is 13.5 °C (Climate data, 2020). The growing season in the study area mainly lasts from late April to late August. The topography is mostly hilly in the region. Oriental beech forests are mostly present on the northern aspect in northern Turkey. In addition to Oriental beech, Scots pine (*Pinus sylvestris* L.), black pine (*Pinus nigra* Arnold.), Trojan fir (*Abies nordmanniana* subsp. *equi-trojani*), Anatolian chestnut (*Castanea sativa* Mill.) and oaks (*Quercus* spp.) are other main tree species of Kastamonu region.

Figure 1. Location of the Kastamonu city and İnebolu area (Google Earth, 2020).

Study Design

The study plots to define the patterns of tree diameter distributions were selected from the database generated by the Regional Forestry Directorate. The database contain data from the temporary measurement plots measured between 2008 and 2011. Tree diameters and species were recorded during the measurements conducted by the Regional Forestry Directorate. In total, thirty plots located within the İnebolu Forest Directorate were selected from the database. The size of the plots was 600 m^2. The stand types of the selected plots were mainly Knbc3, Knbc2, Kncd3, Kncd2, Knc3, Knb3 and Knd2. Diameter at breast height (DBH) measurements of the plots were utilized to calculate the stand basal area (m^2 ha^{-1}), quadratic mean diameter (cm), and the number of trees per hectare of each selected plot (Table 1). Average stand basal area of the selected plots was 28.9 m^2 ha^{-1}, while the average number of trees per hectare and the quadratic mean diameter of the plots were 727 and 23.22, respectively (Table 1). The selected study plots were located in the same region, thus, it is likely that the plots would have similar climatic and soil conditions.

Table 1. Descriptive statistics for stand basal area, trees per hectare, quadratic mean diameter (cm) of Oriental beech plots. SD is the standard deviation.

Variables	Min.	Max.	Mean	SD
Stand basal area (m^2 ha^{-1})	10.22	47.19	28.9	10.12
Tree per hectare	183	1300	727	232.2
Quadratic Mean diameter (cm)	12.71	44.44	23.22	6.71

Analysis

A hierarchical cluster analysis with the Euclidean distance measure was utilized to determine the patterns of tree diameter distributions of Oriental beech forests. Following the Podlaski et al. (2019), the proportions of Oriental beech trees within ten-cm intervals between five to ninety cm as clustering variables were used in the study. It should be noted the analysis was done under four different methods; average, single, complete and Ward methods. The agglomerative coefficient of each method was calculated (Table 2). Next, the strongest clustering with the greater agglomerative coefficient was selected (Table 2) (Murtagh and Legendre, 2011). Table 2 gives the agglomerative coefficient of the selected methods. Based on the calculated agglomerative coefficients of the methods, Ward's method was the strongest clustering method with agglomerative coefficient of 0.861 (Table 2).

Table 2. The agglomerative coefficient values of the selected clustering methods.

Methods	Agglomerative coefficient
Average	0.709
Single	0.563
Complete	0.791
Ward	0.861

Following the determination of the clusters, the optimal number of clusters was obtained. The optimal number of clusters is necessary while using clustering analysis. The Average Silhouette Width Method (Rousseeuw, 1987) was utilized to determine the optimal number of clusters. All statistical analyses and calculations were done using R statistical language (R Core Team, 2014). The "agnes", "hclust" and "pamk" packages of the software were used for the analyses (R Core Team, 2014).

RESULTS and DISCUSSION

Figure 2 below shows the clustering of the selected study plots for the Oriental beech. It should be noted that the numbers assigned to the branches of the clusters refer to the id number of the selected plots (Figure 2). For the study plots of the managed Oriental beech forests, the optimal number of cluster was found to be "two" following the Average Silhouette Width Method (Figure 3). In another words, two main diameter distribution patterns were determined for the Oriental beech forests in the northern Turkey following the clustering analysis (Figure 3).

In figure 3, each rectangle with different border color (i.e., red and green) refers to a different diameter distribution pattern. The first diameter distribution pattern was represented by twenty-two plots, while the second diameter distribution pattern comprised of eight study plots (Figure 3).

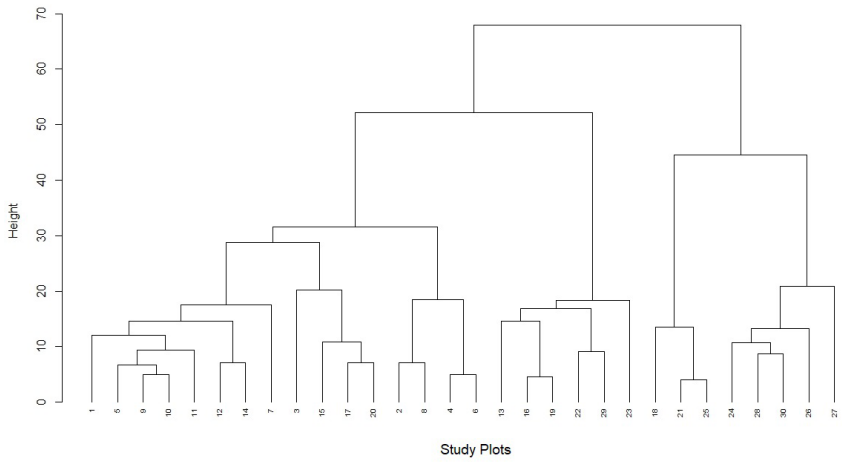

Figure 2. Clustering analysis of the selected plots of Oriental beech forests.

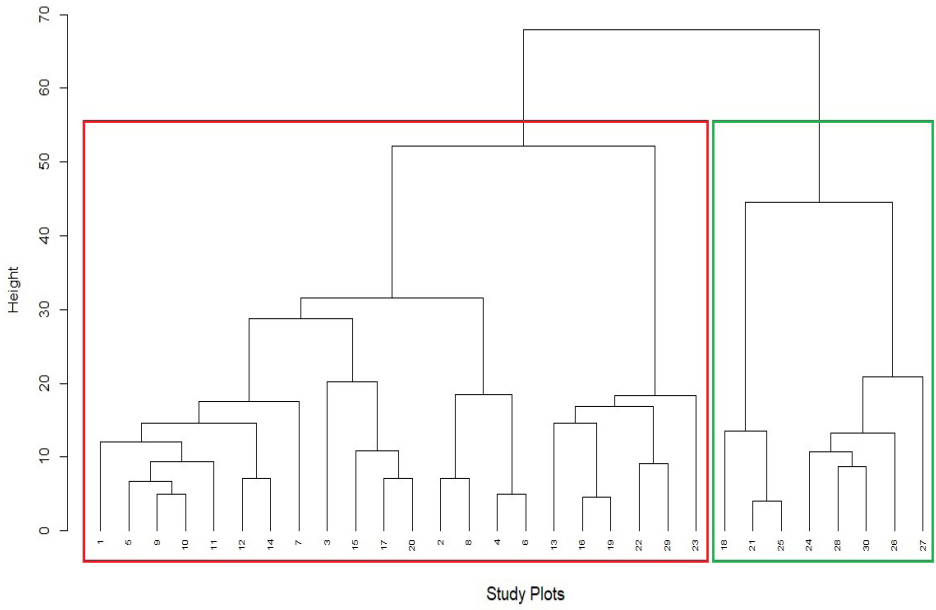

Figure 3. Clusters obtained for the Oriental beech forests. Red and green rectangles represent the diameter distribution patterns.

Figure 4 represents the potential diameter distribution of the first diameter distribution pattern. To do this, the average number of trees for each diameter class was calculated using the data from the selected plots of each pattern. For example, for the second diameter distribution pattern, the average number of trees per hectare (by the diameter classes) of the representing plots (i.e., plots 18, 21, 24, 25, 26, 27, 28, and 30) was utilized and averaged (Figure 5). The same procedure was followed for the first diameter distribution pattern as well (Figure 4).

In the first diameter distribution pattern, all diameter classes included beech trees, but the most trees were in 20-cm diameter class, followed by 30-cm, 10-cm and 40-cm diameter classes (Figure 4). Following the 10-cm diameter class, the first diameter distribution pattern represented a decreasing number of trees per hectare with increasing diameter classes (Figure 4). This pattern can be observed within the stands of shade-tolerant and semi-tolerant tree species such as Oriental beech (Odabaşı et al., 2004).

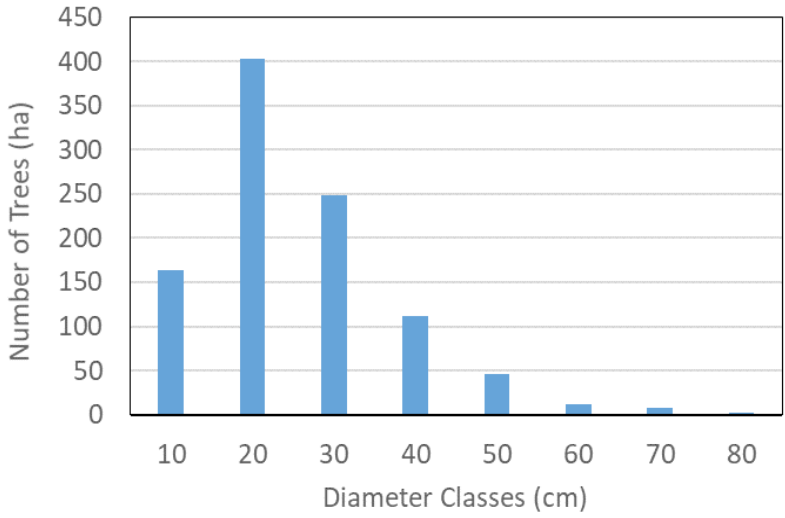

Figure 4. The potential diameter distributions of the first diameter distribution pattern.

As for the second diameter distributions pattern, most of the trees were smaller diameter classes (i.e., 10, 20, 30-cm diameter classes) (Figure 5). The most trees were in the 20-cm diameter class as observed in the first diameter distribution pattern (Figure 4 and Figure 5). In addition, this diameter distribution pattern did not include any trees within the 60 and 80-cm diameter classes, while few trees were present within the 70-cm diameter class (Figure 5). This is likely because the stand types of the plots that created this pattern were mainly Knbc3 and Knb3 which basically refer to relatively young stands.

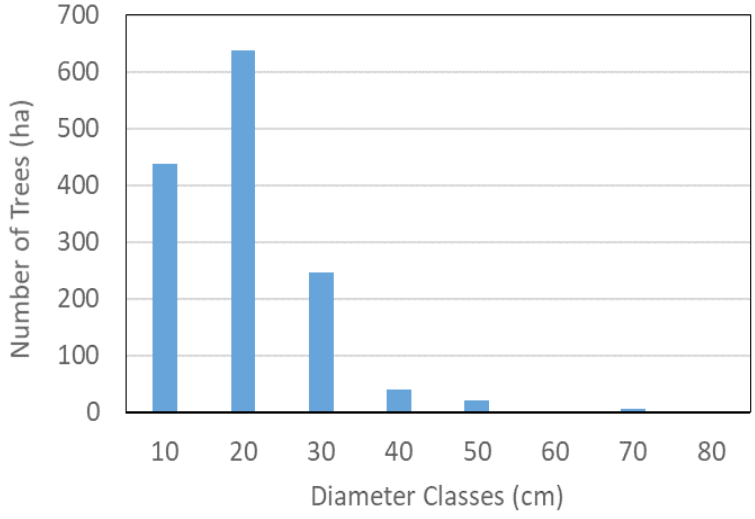

Figure 5. The potential diameter distributions of the the second diameter distribution pattern.

Oriental beech is a shade tolerant tree species (Odabaşı et al., 2004). Oriental beech seedlings can develop under relatively higher stand density (Szwagrzyk et al., 2001). Adequate number of Oriental beech seedlings can be usually attained under the canopy of overstory trees. Therefore, a higher number of Oriental beech trees was commonly expected in the smaller size diameter classes. Due to the tolerance of Oriental beech trees to shady stand conditions, Oriental beech seedlings and saplings can be observed under varying light intensities (Parhizkar et al., 2011).

However, establishment of Oriental beech seedlings into the overstory in the following years usually depends on the gradually decreasing overstory tree density (Odabaşı et al., 2004). Despite their tolerance to shady conditions, light availability in the understory is vital for the seedling growth and seedling density of shade-tolerant tree species (Drever et al., 1994). This points out the importance of stand structure in Oriental beech forests.

Stands of Oriental beech have been mainly managed using the traditional shelter-wood method. Therefore, overstory disturbances created by the shelter-wood cuttings (i.e., thinning) can create favorable stand conditions for the species. These disturbances are utilized to emulate the natural stand dynamics in these forests within the region. Thus, a higher number of trees in the smaller diameter classes, as we observed in this study, is logical and expected in Oriental beech forests.

The characteristics of vertical and horizontal structure of forests can influence biological diversity (Kerr, 1999). The availability of trees in most of the diameter classes in the first diameter distribution pattern can be characterized by the vertical structural complexity. This coincide with the notion that forest structural complexity can be improved by silvicultural treatments as well (Keren et al., 2017).

It should be noted that this chapter represents the recent diameter distribution patterns in the managed Oriental beech forests of northern Turkey. Therefore, the patterns obtained in this study are subject to changes through the time. Previous research has stated that diameter distribution patterns are usually dynamic (Podlaski et al. 2019), and they might be maintained via different management strategies.

Conclusions

This study determined the diameter distribution patterns in the managed Oriental beech forests of northern Turkey, using the hierarchical cluster analysis. Two main diameter distribution patterns were attained for these forests. In general, most of the trees were in smaller diameter classes in both diameter distribution patterns. Second pattern lacked trees in larger diameter classes, due to the stand type of plots that created the second pattern. The study highlights the importance of the overstory disturbances through the shelter-wood cuttings

to establish and recruit adequate number of beech trees into small diameter sizes in Oriental beech forests of northern Turkey. These forests should be monitored in long term to see if the attained diameter distribution patterns in these forests would change through time. The diameter distribution patterns obtained in this study would contribute future studies that aim to enhance and maintain the forest structural complexity in Oriental beech forests in northern Turkey

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Chapter 6

DETERMINATION OF ENERGY POTENTIAL OF AGRICULTURAL BIOMASS OF ADIYAMAN PROVINCE

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Introduction

Energy is a vital need for humanity. The rapid increase of global population and the developing life standards as a consequence of advancements in technology is increasing the need for energy by each passing day. As fossil fuels are limited and are coming to an end, there is a growing number of studies on using renewable (alternative, sustainable) energy resources (Külcü, 1985; Kuş et al., 2016). Fossil-based energy has its own downsides and therefore studies are concentrating on sustainable, eco-friendly and economic resources. These energy resources can be listed as hydraulic, geothermal, hydrogen, wind, wave, tidal, solar and biomass (Shepherd and Shepherd, 1998; Kuş et al., 2016).

Renewable energy has become an indispensable part of energy sector for various reasons such as energy supply safety and decreasing greenhouse emissions. For many centuries biomass has been traditionally and mostly used for domestic heating but thanks to advancing energy technologies it is now also being used in transport and power generation and public incentives granted for biomass investments have entered into a rapid development stage. Biomass means the organic matter mass of plants and animals (Acaroğlu et al., 2005; Balat et al., 2006; Sözen et al., 2017; Karabaş, 2019).

A study of Turkey's energy balance for the past few years indicates that it is consuming about three times the energy value it is producing and is importing about 70% of this value. The energy projection of Turkey for the short and long term leads to an anticipation of great increases both in consumption values and in production values. The main energy resources produced in Turkey are coal, hydroelectric and biomass energies (Anonym, 2011; Aybek et al., 2015; Taşova and Polatcı, 2019). The annual average biomass potential of Turkey is estimated to be 109.4 million tons. The annual biomass waste in forestlands of Turkey is reported to be between 5 and 7 million tons (shell, leaf, chip, branch etc.). This supports the argument that Turkey is extremely rich in organic wastes (Sümer et al., 2016; Şenol et al., 2017).

In Turkey, most of the wastes left after agricultural production are either burned or left in the field. The administration of unprocessed animal and farm wastes to agricultural land leads to the harmful substances reducing fertility of agricultural land and they also cause environmental pollution (Başçetinçelik et al., 2005; DBFZ, 2011; Anonym, 2012; Anonym, 2013a; Anonym, 2013b; Sümer et al., 2016). Some studies have already been conducted on agricultural biomass and energy potentials. Some of these are; Afyonkarahisar (Külcü, 2016), Çanakkale (Sümer et al., 2016), Iğdır (Kuş et al., 2016), Antalya (Karaca, 2017), Tokat (Taşova and Polatcı, 2019) etc. This study has defined the agricultural biomass and energy potential of Adıyaman province and relevant calculations have been made.

Material and Method

Adıyaman is surrounded by Çelikhan in north, Kahta in east, Samsat and Atatürk Dam Lake in southeast and Euphrates River in east and Besni district and Tut district in west. Including the Central district, there are a total of 9 districts and 406 villages. The districts are Central, Besni, Çelikhan, Gerger, Gölbaşı, Kahta, Samsat, Sincik and Tut districts. Adıyaman province is located between 37^0 25' and 38^0 11' north latitude, 37^0 and 39^0 east longitude. The land area of Adıyaman province is 7614 km^2 or 7871 km^2 if lakes are included and the elevation from sea-level is 669 m (Anonym, 2020a). Adıyaman province's agricultural structure per district is given in Table 1 and an agricultural area per district is given in Table 2.

The advantages of making agricultural investment in Adıyaman province are the climate and topographic characteristics, transport facilities, a significant agricultural potential, cheap labour force, possibility of product variety and yielding more than one product per year, irrigation potential and the significant quantity of irrigable land, existence of Atatürk Dam and natural lakes, opening of new irrigation areas, existence of resources suitable for aquaculture, existence of rich natural flora and micro climate areas suitable for greenhouse, organic fruits and organic honey production, areas suitable for producing fodder plant to be used in husbandry investments, existence of land suitable for organic agriculture and rich petrol resources and geothermal resources (Anonym, 2020b).

Table 1. Agricultural structure of Adıyaman province (Anonym, 2020c)

Adıyaman	Cereals and other herbal products		Vegetable	Fruits, beverage and spice herbs	Ornamental plants	Total area
	Cultivated	Fallow				
Total (da)	1706542	6457	55801	537693	-	**2306493**

Table 2. Agricultural areas of the districts of Adıyaman province (Anonym, 2020c)

Districts	Agricultural area (da)	Ratio* (%)
Besni	591672	25.65
Gerger	72677	3.15
Gölbaşı	175741	7.62
Kahta	571890	24.79
Central	684340	29.67
Samsat	90235	3.91
Sincik	39071	1.69
Tut	69572	3.02
Çelikhan	11295	0.49
Total	**2306493**	**100**

*Calculated.

Analysing the agricultural structure of Adıyaman province through Table 1 indicates that areas cultivated with cereals and other herbal products corresponds to 1706542 da, fallow area to 6457 da, vegetable gardens to 55801 da, fruit beverage and spice herbs etc. to 537693 da, which all cover a total agricultural area of 2306493 da. Looking at the agricultural areas of Adıyaman province per district (Table 2); the leading three districts are Central district by 684340 da, Besni district by 591672 da and Kahta district by 571890 da.

2019 data of the Turkish Statistical Institute have been used to determine the agricultural biomass potential of Adıyaman province in this study. According to Kuş et al. (2016), "the production area quantities of product groups have been determined and the annual dry biomass quantities have been calculated over these areas. All the wastes acquired from unit area have been taken into consideration as dry biomass quantities are calculated over herbal production areas. Furthermore, fallow land have also been taken into consideration in biomass calculations and the biomass quantities that could be acquired if those areas were used have also been calculated."

80-100 ton fresh and 25-30 ton dry biomass can be achieved annually from a hectare semi-fertile area (Balat, 2005; Kuş et al., 2016). In this sense, it has been assumed that 27.5 ton dry biomass can be achieved on average form a hectare. In general, the thermal value of dry biomass ranges between 3800-4300 kcal kg^{-1} (Koçer and Ünlü, 2007; Kuş et al., 2016). Equation 2 has been used for calculating the average dry biomass thermal value of each product group. 1 kcal = 1.10^{-7} TEP and 1 TEP = 11.63 MW equations have been used to determine the energy equivalence of agricultural biomass in calculations (Anonym, 2014; Kuş et al., 2016). Accordingly, Equation 1, Equation 2 and Equation 3 have been used when calculating the average dry biomass quantity, average dry biomass thermal value and average dry biomass energy value that can be produced annually (Kuş et al., 2016).

The method observed in calculations;

$$OKBM = \left(\frac{25+30}{2}\right) * A \quad (1)$$

$$OBID = OKBM * \left(\frac{3800+4300}{2}\right) \quad (2)$$

$$OBED = OBID * 1.10^{-7} \quad (3)$$

OKBM = Average dry biomass quantities (ton)

OBID = Average dry biomass calorific value (kcal kg^{-1})

OBED = Average dry biomass energy value (TEP)

A = Area (ha)

Results and Discussion

The average dry mass biomass quantities of herbal production areas in Adıyaman province and its districts are given in Table 3.

Table 3. Adıyaman province its districts average dry biomass quantities (ton)

Districts	Agricultural* area (ha)	Average dry biomass quantity (ton)
Besni	59167.2	1627098
Gerger	7267.7	199861.8
Gölbaşı	17574.1	483287.8
Kahta	57189	1572698
Central	68434	1881935
Samsat	9023.5	248146.3
Sincik	3907.1	107445.3
Tut	6957.2	191323
Çelikhan	1129.5	31061.25
Total	**230649.3**	**6342856**

* (Anonym, 2020c)

As Table 3 indicates, the average dry biomass quantity that could be achieved in Adıyaman from an agricultural area of 230649.3 ha is 6342856 tons. The leading three districts are Central district by 1881935 tons, Besni district by 1627098 tons and Kahta district by 1572698 tons. The average dry energy values of Adıyaman province and its districts are given in Table 4. In other similar studies conducted; Kuş et al. (2016) defined the average dry biomass quantity as 2469693 tons for Iğdır province, Karabaş (2019) has defined the average dry biomass quantity as 974990.8 tons for Sakarya province and Külcü (2016) has defined the average dry biomass quantity as 2838954 tons for Afyonkarahisar province.

Table 4. OKBM energy values of Adıyaman province and its districts (TEP)

Districts	Average dry biomass quantity (ton)	Average dry biomass quantity energy value (TEP)
Besni	1627098	658974.7
Gerger	199861.8	80944.01
Gölbaşı	483287.8	195731.5
Kahta	1572698	636942.5
Central	1881935	762183.7
Samsat	248146.3	100499.2
Sincik	107445.3	43515.33
Tut	191323	77485.82
Çelikhan	31061.25	12579.81
Total	**6342856**	**2568857**

According to Table 4; the average dry biomass energy value that could be achieved from a total of 230649.3 ha agricultural area in Adıyaman province is 2568857 TEP. The leading three districts are Central district by 762183.7 TEP, Besni district by 658974.7 TEP and Kahta district by 636942.5 TEP. In other studies conducted, Kuş et al. (2016) have defined the average dry biomass energy value as 1000226 TEP for Iğdır province, Kurt and Nacar Koçer (2010) have defined the average dry biomass energy value as 1596786.4 TEP for Malatya province and Külcü (2016) has defined the average dry biomass energy value as 323841 TEP for Afyonkarahisar province. The average dry energy values of Adıyaman province and its districts are given as GWh in Table 4.

Table 5. OKBM energy values of Adıyaman province and its districts (GWh)

Districts	Average dry biomass quantity (TEP)	Average dry biomass quantity energy value (GWh)	Ratio (%)
Besni	658974.7	7663.9	25.65
Gerger	80944.01	941.4	3.15
Gölbaşı	195731.5	2276.4	7.62
Kahta	636942.5	7407.6	24.79
Central	762183.7	8864.2	29.67
Samsat	100499.2	1168.8	3.91
Sincik	43515.33	506.1	1.69
Tut	77485.82	901.2	3.02
Çelikhan	12579.81	146.3	0.49
Total	**2568857**	**29875.8**	**100**

According to Table 5; the average dry biomass energy value that could be achieved from a total of 230649.3 ha agricultural area in Adıyaman province is 29875.8 GWh. The leading three districts are Central district by 8864.2 GWh. (29.67%), Besni district by 7663.9 GWh. (25.65%) and Kahta district by 7407.6 (24.79%) GWh.

Conclusions

The study findings have determined the biomass and energy potentials of herbal production wastes in Adıyaman province for the year 2019 and calculations have been made accordingly. According to these calculations, agricultural production is conducted in an agricultural area of 230649.3 ha and an average of 6342856 ton dry biomass potential has been realized. It has also been calculated that there is an average of 6342856 ton/year dry biomass potential in the agricultural production conducted in Adıyaman province, which corresponds to 2568857 TEP/year worth of energy.

In order to ensure optimum use of biomass both domestically and regionally, traditional use needs to be supplemented by conversion to bioenergy in modern

facilities and this requires feasibility studies. First of all, it is highly important that the biomass potential in all our regions is defined in an annual basis, cost calculation needs to be made and the locations of energy generation plants need to be defined (Kuş et al., 2016).

Adıyaman is one of the prominent provinces in Turkey in terms of agricultural production and the energy potential of the province that could be generated from the agricultural wastes can be used to provide energy for the heating and other needs of agricultural enterprises. This clean and renewable energy could reduce costs and contribute greatly to local and national economy.

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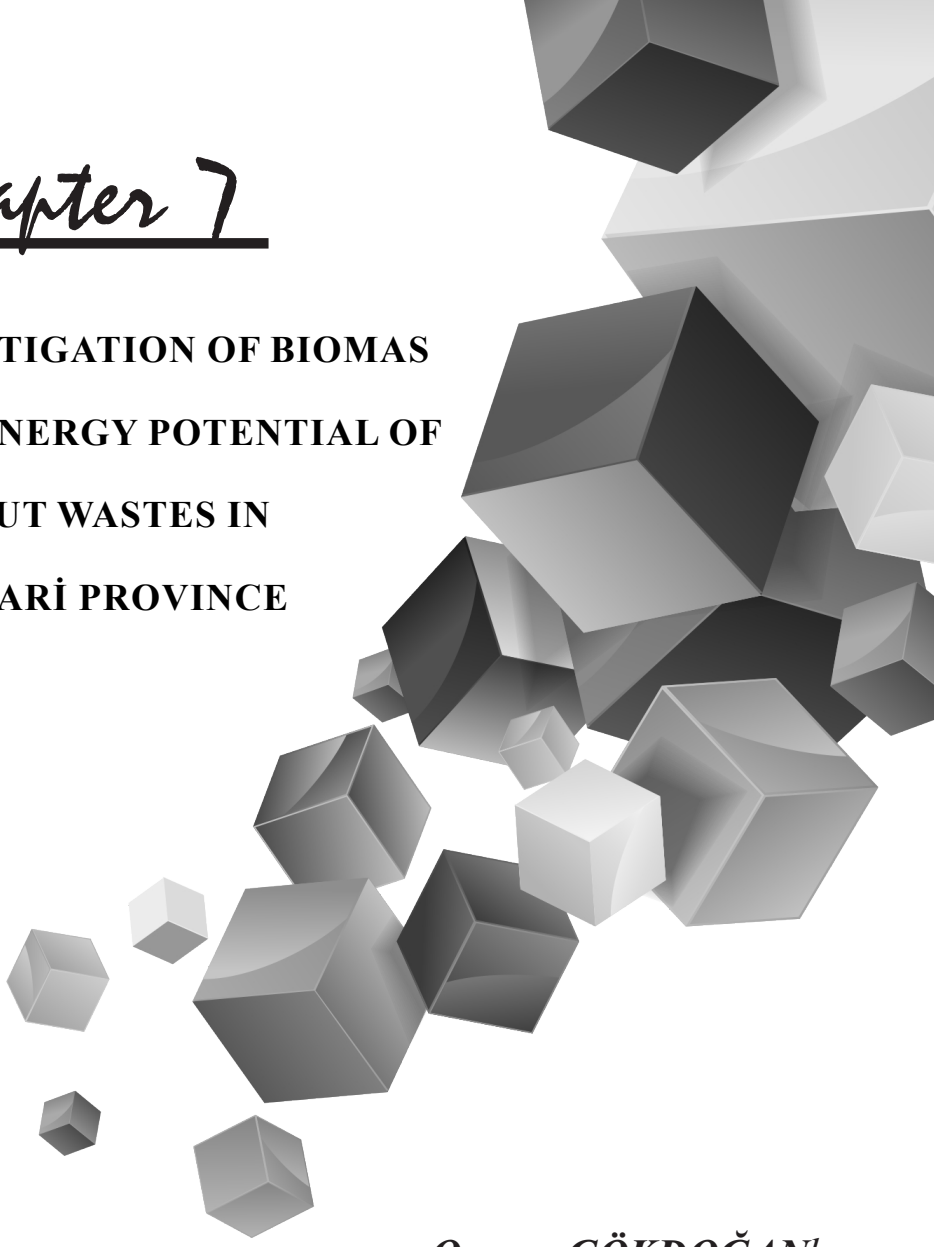
Chapter 7

INVESTIGATION OF BIOMAS AND ENERGY POTENTIAL OF WALNUT WASTES IN HAKKARİ PROVINCE



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Introduction

Turkey has a long tradition of fruit growing and, as it the case with many fruits, it is considered to be one of the motherlands of walnut. Different regions of Turkey have different walnut trees with varying fruit characteristics. Walnut is a type of fruit that has a great variety of use unlike any other type of fruit. All of its compounds, such as the green and hard shell, fruit, leaf, root and trunk, can be made use of and its cultivation is highly important both in our country and in the world (Şen, 1986; Akça, 2001; Yıldız and Çolak, 2018). Walnut is an important plant that has been used in the fields of nutrition and health since the ancient times. Having a high nutritional value, walnut contains thiamine, vitamin B6 and folacin vitamins. It is further rich in iron, zinc, copper, magnesium, phosphorus and potassium. High protein content (14 g protein in 100 g of crushed walnut) makes walnut an important nutrient (Akça 2016; Göçmen, 2017).

Nowadays consumption habits and increases in income levels of people are varied and this leads to an increased demand to certain agricultural products. Turkey has an important potential in global agriculture due to her ecologic characteristics. Turkey is the gene centre and one of the homelands of walnut (Akça, 2010; Ketenci and Bayramoğlu, 2018). According to 2019 data, total walnut production in Turkey was 225000 tons, and the leading three provinces were Hakkari by 11682 tons, followed by Kahramanmaraş by 11436 tons and Mersin by 10838 tons. Walnut production in Hakkari province corresponds to 5.19% of Turkey's total walnut production (Anonym, 2020a).

Further to providing food for humans and animals, agricultural products are also important input sources for industry and important export items. But the rapidly increasing population and developing industrialization creates bigger need for energy. Energy resources need to be renewable to ensure undisrupted supply of energy without causing environmental pollution. Biomass energy is an infinite source and it has a particular socio-economic value for rural areas (Bilgen et al., 2008; Kurt and Nacar Koçer, 2010; Koç and Şenel, 2013; Karabaş, 2019). Biomass is the storing of solar energy in plants in a chemical structure. Biomass contains cellulose, hemicelluloses, lignin, fats, proteins, starch, simple sugars, HC, water, ash and other compounds. Celluloses and hemicelluloses are two carbohydrates with significant value. Reclaiming the solar energy stored in plants and animals or in their wastes, as biomass energy can be possible by burning the biomass as fuel (Demirbaş 2005; Karaca, 2017).

Turkey's basic domestic energy resources are lignite, hydroelectric and biomass. The annual biomass energy potential of Turkey is approximately 32 MTEP and biomass quantity is 117 Mt $yıl^{-1}$ (Karaca, 2015; Karaca, 2017). Global biomass energy production is approximately 985 Mt $yıl^{-1}$. The share of biomass energy in world energy consumption is 12.2%. Biomass energy corresponds to only 5.4% within the primary energy consumption in OECD countries and 26% of the primary energy consumption in non-OECD countries (IEA, 2015; Karaca 2015; Karaca, 2017). Hence, the greatest share in CO_2 emission in the world

belongs to OECD countries (37.4%). They are followed by China by a share of 28%. And the share of Turkey in global CO_2 emission is around 0.9% (IEA, 2015; Karaca, 2017). A number of studies have been conducted on biomass quantity and energy potentials. For instance; Malatya (Kurt and Nacar Koçer, 2010), Sivas (Topal and Arslan Topal, 2012), Afyonkarahisar (Külcü, 2016), Çanakkale (Sümer et al, 2016), Iğdır (Kuş et al., 2016), Antalya (Karaca, 2017), Aydın (Akbaş, 2019), Tokat (Taşova and Ergüneş, 2018), Sakarya (Karabaş, 2019) among others. This study has defined the biomass and energy potential, along with the calculations, of the walnut residues in Hakkari province, which is the leading walnut producer in Turkey.

Material and Method

Hakkari is a border province located at the south-eastern end of the East Anatolia Region, between 42° 10' and 44° 50' east longitudes and 36° 57' and 37° 48' north latitudes. The elevation of the town centre from sea level is 1720 m. Its land area of 9521 km^2 is surrounded by Iraq in south, Iran in east; Van province in north and Şırnak province in west. About 88% of the geographical structures are mountains and 86% of the land area is suitable for agriculture. However, the share of actual cultivated area within the province is a mere 1.4%. Annual average temperature of Hakkari is higher than many other provinces in Eastern Anatolia. This is caused by the fact that Hakkari is located in the southern part of Eastern Anatolia and therefore it is dominated by the Mediterranean Climate. Central Hakkari has an annual average temperature of 9.9. The annual average precipitation in the province is 791.7 mm. This value is much higher than those in many provincial centres in Eastern Anatolia. The corresponding values in neighbouring provinces are 384 mm in Van, 756.2 mm in Siirt and 713.4 mm in Mardin. The greatest quantity of precipitation in the province falls in March and April, and the least is experienced in July and August (Anonym, 2020b).

70% of the population in Hakkari earn their livelihood through agriculture. 50% of that population is also breeding animals. Furthermore, the province is also highly suitable for intensive and semi-intensive production activities such as bee-keeping, aquaculture and silk-worm breeding. Hakkari is an important centre of attraction for beekeeping and aquaculture as it is rich in water resources, has a wide range of agricultural land, is free from serious environmental pollution, has an unharmed nature as land and nature have not been tampered and has a rich floristic structure. Based on cultivation areas, the leading five filed crops are respectively forage plants (clover, trefoil and vetch), wheat, barley, tobacco and rice. The prominent vegetables are tomato, cucumber and watermelon. The most commonly grown fruits are walnut, grape, apple, pomegranate and fig, among many others (Anonym, 2020c). Agricultural structure of Hakkari province is given in Table 1 and the agricultural areas per district are given in Table 2.

Table 1. Agricultural structure of Hakkari province (Anonym, 2020a)

Hakkari	Cereals and other herbal products		Vegetable	Fruits, beverage and spice herbs	Ornamental plants	Total area
	Cultivated	Fallow				
Total (da)	348614	6600	22680	53502	-	**431396**

Table 2. Agricultural areas of the districts of Hakkari province (Anonym, 2020a)

Districts	Derecik	Central	Yüksekova	Çukurca	Şemdinli
Agricultural area (da)	31750	86748	252906	14118	45874
Total area (da)	**431396**				

Looking at the agricultural structure of Hakkari province given in Table 1; the total area cultivated with cereals and other herbal products is 348614 da, fallow area is 6600 da, vegetable area is 22680 da, fruits beverage and spice herbs areas is 53502 da and the total agricultural area covers 431396 da. Looking at the agricultural areas per district in Hakkari (Table 2), Yüksekova district has 252906 da, Central district 86748 da, Şemdinli 45874 da, Derecik 31750 da and Çukurca has 14118 da. Walnut cultivation areas and the relevant quantities are given in Table 3.

Table 3. Walnut cultivation areas and quantities of Hakkari province (Anonym, 2020a)

Districts	Yield (kg/tree)	Yield quantity (ton)	Cultivation area (da)	Area ratio* (%)
Derecik	20	793	2355	8.64
Central	24	7205	16000	58.72
Yüksekova	23	1775	4170	15.30
Çukurca	22	746	1875	6.88
Şemdinli	21	1163	2850	10.46
Total	**-**	**11682**	**27250**	**100**

*Calculated.

According to Table 3; walnut is being cultivated in an area of 27250 da in Hakkari province. As per the walnut cultivating districts, Central district leads by 16000 da (58.72%), followed by Yüksekova district by 4170 da (15.30%), Şemdinli district by 2850 da (10.46%), Derecik district by 2355 da (8.64%) and Çukurca district by 1875 da (6.88%). Walnut production values in Hakkari province are as follows: Central district 7205 tons, Yüksekova district 1775

tons, Şemdinli district 1163 tons, Derecik district 793 tons and Çukurca district 746 tons. And the yield per tree is: Central district 24 kg/tree, Yüksekova 23 kg/tree, Çukurca 22 kg/tree, Şemdinli 21 kg/tree and Derecik 20 kg/tree.

2019 data acquired from the Turkish Statistical Institute have been used in the data. The quantity of areas where walnut was cultivated in Hakkari province in 2019 have been defined (along with walnut waste and energy potential) and the annual average fresh waste and dry matter potential quantities have been calculated for these areas. In their study, Taşova and Ergüneş (2018) calculated the fresh waste and dry matter potential quantities that could be acquired per hectare from a walnut field with ordinary fertility, by using Balat (2005) method (1, 2).

Fresh waste = Area * 90 (1)
Area = Walnut area (ha)
90 = Average annual fresh walnut waste that can be acquired from an average ha walnut area (regarding shell and branch: 80-100 ton)

Dry matter = Area * 27.5 (2)
27.5 = Average dry matter that can be acquired from an average ha walnut area (25-30 ton)

According to Taşova and Ergüneş (2018); "A thermal energy of 4816 kcal kg^{-1} (20.16 MJ kg^{-1}) is released by the shells of dry walnut fruits and 4534 kcal kg^{-1} (18.98 MJ kg^{-1}) is released by branch waste (Tırıs, 2014; Kuş et al., 2016)".

Energy potential = Dry matter * 1000 * 19.57 (3)
1000 = To convert the unit of ton into kilogram
19.57 = Thermal energy that can be acquired from an average kg of walnut waste (MJ)

Results and Discussion

The average fresh waste and dry matter potential quantities calculated for the walnut cultivation areas in Hakkari province is given in Table 4.

Table 4. Average fresh waste and dry matter potential quantities of Hakkari province

Districts	Cultivation area* (ha)	Fresh waste (ton/year)	Dry matter (ton/year)
Derecik	235.5	21195	6476.25
Central	1600	144000	44000
Yüksekova	417	37530	11467.50
Çukurca	187.5	16875	5156.25
Şemdinli	285	25650	7837.50
Total	**2725**	**245250**	**74937.50**

*(Anonym, 2020a)

According to Table 4; the total average walnut waste potential of Hakkari province for the year 2019 was 245250 tons. On the basis of fresh waste potential quantities that could be acquired, the Central district leads by 144000 ton/year, followed Yüksekova district by 37530 ton/year, Şemdinli district by 25650 ton/year, Derecik district by 21195 ton/year and Çukurca district by 16875 ton/year. On the basis of dry matter potential quantites that could be acquired, Central district leads by 44000 ton/year, followed by Yüksekova district by 11467.50 ton/year, Şemdinli district by 7837.50 ton/year, Derecik district by 6476.25 ton/year and Çukurca district by 5156.25 ton/year. The energy potential quantities that could be acquired from walnut wastes of Hakkari province are given in Table 5.

Table 5. Energy potential quantities acquired from walnut wastes of Hakkari province

Districts	Dry matter quantity (ton/year)	Energy values*			
		MJ/year	kWh/year	GJ/year	TEP/year
Derecik	6476.25	126740212.50	35205614.58	126740.21	3027.14
Central	44000	861080000	239188888.89	861080	20566.54
Yüksekova	11467.50	224418975	62338604.17	224418.98	5360.16
Çukurca	5156.25	100907812.50	28029947.92	100907.81	2410.14
Şemdinli	7837.50	153379875	42605520.83	153379.88	3663.42
Total	**74937.50**	**1466526875**	**407368576.39**	**1466526.88**	**35027.39**

* In the calculations (Anonym, 2020d) has been used.

According to Table 5; the total energy potential that could be acquired from walnut wastes in Hakkari province have been calculated as 1466526875 MJ/year, 407368576.39 kWh/year, 1466526.88 GJ/year and 35027.39 TEP/year. In terms of energy potential per district, the figures are as follows: Central district 20566.54 TEP/year, Yüksekova district 5360.16 TEP/year, Şemdinli district 3663.42 TEP/year, Derecik district 3027.14 TEP/year and Çukurca district 2410.14 TEP/year. In previous studies, Külcü (2016) has calculated an agricultural waste energy potential of 323841 TEP for Afyonkarahisar province, Taşova and Ergüneş (2018) calculated a walnut waste energy potential of 22607

TEP/year for Tokat province and Karabaş (2019) calculated an agricultural waste energy potential of 566096472 GJ/year for Sakarya province.

Conclusions

Based on the study findings, the biomass and energy potentials of walnut wastes in Hakkari province have been defined for the year 2019 and relevant calculations have been made. According to these calculations; walnut cultivation is taking place in an area of 27250 da, yielding 11682 tons of walnut. It has also been calculated that this quantity of walnut production can yield a total of 245250 ton/year fresh waste and 74937.50 ton/year dry matter, which corresponds to 35027.39 TEP/year energy.

The main target of energy policies must be providing continuous, clean, reliable and cheap energy. Energy generated under these conditions need to be used efficiently but it is also important to ensure resource variety. The importance of recycling zero-waste target has increased nowadays, and in terms of energy supply, the wastes of plants with a biomass potential must be contributed to the economy (Karabaş, 2019).

Walnut trimming and shell materials are burned directly and used for heating and cooking purposes in rural areas but they can also be used for energy conversion technologies (such as gasification and pyrolysis) to acquire electricity and biofuel. Processing walnut fruit in industrial enterprises will allow more regular production of its shell. This way, enterprises will be able to use the shells for their own energy needs and sell the surplus as energy raw material (Ünal, 2005).

Hakkari is the leading province in terms of walnut cultivation areas in Turkey, hence it has a great energy potential from walnut wastes. By using energy conversion systems, these wastes can be converted into energy and this would provide a clean and renewable energy source to agricultural enterprises for heating, lighting and other energy needs and reduce their costs.

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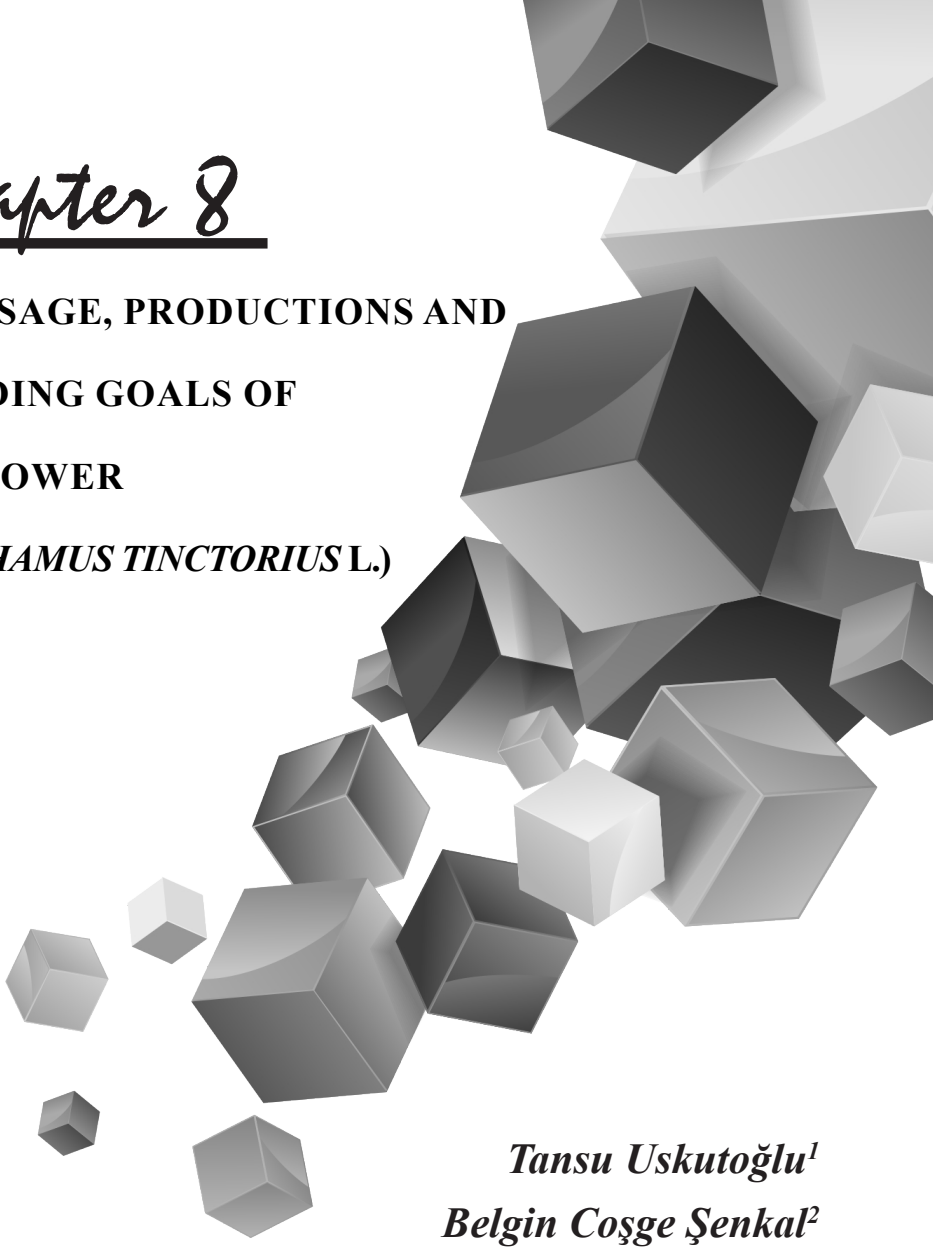
Chapter 8

THE USAGE, PRODUCTIONS AND BREEDING GOALS OF SAFFLOWER (*CARTHAMUS TINCTORIUS* L.)



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Introduction

Safflower (*Carthamus tinctorius* L., Compositae) is herbaceous and annual plant. It is self-polination and diploid (2n = 24). Safflower is a bushy, upright and cylindrical stems and ovate or ovate–lanceolate leaves, on which there might be spines (Zhou et al., 2014). There are varietis of safflower with and without spiny. False Saffron, Dyer's Saffron and Zaffer are also the other well-known names of safflower (Gautam, 2015). Safflower flowers has been using for adds flavour and colour on foods, as cut flowers and dyes in textile industry. It is also used traditionally as vegetable, herbal teas and medicinal purposes (Mundel et al., 1992; Mahasi et al., 2006; Emongor, 2010).

It has a high adaptation to arid areas due to its pile root, which can go 2.5-3.0 m deep. The petals of safflower are yellow, orange, and red colors. Safflower seeds are usually white but can striped, 6-7 mm long, and an average 1000 seed weight of 30-45 g, and these seeds contain about 35-40% oil and 20% protein (Li and Mündel, 1996). Generally, the vegetation period varies between 130-160 days. Safflower different development stage shown in Figure 1. Safflower oil is the richest in polyunsaturated fatty acid (linoleic acid, 77%). Therefore, the improvement studies of safflower have increased in recent years.

In this study, up-to-date information about the usage areas of safflower plant, its economic importance and breeding purposes are given.

1. Usage of safflower

a) Nutrition

Safflower seed consists 13-46% oil and 15-20% protein (Rahamatalla et al., 2001). Safflower seed oil is used as cooking oil (also making margarine and salad oil) in human nutrition due to its unsaturated fatty acids ratio in total fatty acids are around 90-93% (Dordas and Sioulas, 2008; Emongor, 2010; Shahrokhnia and Sepaskhah, 2016). Safflower plants which are rich in vitatamin A, iron, phosphorus, and calcium at a tender age are consumed as a leafy vegetable in India (Knowles, 1969) (Figure 1b,c).

Safflower seed is an expensive feed raw material used in the feeding of poultry animals, especially pet animals (Mündel et al., 2004). The oil ratio of safflower pulp used as feeding stuff is between 2-15% (Weiss, 2000). Safflower seeds are used as birdseed. Both seed and seed meal can be included in the diet of rabbits, gerbils, hamsters, and dhinchillas (Mündel et al., 2004).

b) Medicinal plant

Safflower is grown as a medicinal plant for the treatment of neurotropic, hemopoietic, diaphoretic systems, cardiovascular diseases, cerebrovascular, and gynecological complications (Lin et al., 1992; Kono et al., 2002). In addition, safflower has been used to reduce high blood pressure by increasing the blood

flow in the vessels, allowing the tissues to receive more oxygen. It has also been used as a pain reliever and fever reliever in the treatment of swelling and pain caused by trauma (Bocheva et al., 2003). It has been used as an antidote in poisoning and against constipation in Middle Eastern countries, India and Africa (Kneusel et al., 1994). In Bangladesh, ground safflower seeds were mixed with mustard oil and used as an ointment against rheumatism (Babaoglu, 2008).

Safflower plant has high biological activity due to phytochemical including quinochalcones, flavonoids, alkaloids, polyacetylenes, and other biological active compounds. Present, many pharmaceutical studies are concentrated on this plant ethno-pharmaceutical applications in terms of antioxidation, anti-inflammation and anti-epilepsy (Jun et al., 2011; Kruawan and Kangsadalampai, 2006).

Figure 1. *Safflower different development stage a-) emerge b-) rosette stage c-) beginning of stem elongation d-) branching e-) flowering f-) dry seed g-) white flower h-) red flower i-) yellow flower (Yozgat-2020)*

c) Cut flower

In many countries such as in Western Europe, Japan, Latin America, and Kenya etc., safflower is grown as cut flower. Varieties without spiny are used for this purpose. Particulalyr the floral stems are used for ornamentation, in religious temples in virtue of durability. More recently it is an important part of flower auctions in Holland and it is accepted among the 46 most commercialized cut flowers (Coronado, 2010; Emongor and Oagile, 2017).

d) Natural Dye

The florets of safflower have been well documented for yellow and red quinochalcone natural dyes properties, such as safflower yellow, safflomin, precarthamin, and carthamin (Cho and Hahn, 2000). A red quinochalcone isolated from safflower called as carthamin used as not only natural food and cosmetic colorant but also as nutraceutical in food industry (Wu, et al., 2013).

Color substances such as carthamidin (27.0-29.0%) and carthamin (0.70-0.96%), which are naturally synthesized in safflower flowers, are used in medicine to give color and taste to natural coloring foods, as a dye source in textiles and to regulate insulin levels (Qazi et al, 2016). Carthamidin is water soluble and gives yellow color. However, the more important carthamin is not soluble in water, but dissolves in basic solutions and gives an orange red color (Baydar and Erbaş, 2014). Safflower flowers are picked as a source of spice (instead of saffron) and dyes in the early hours of the morning, dried in the shade (by hand or machine), and a dry flower yield of 5-20 kg/da is obtained depending on the variety. (Weiss, 2000).

2. Safflower production around the world

Safflower is grown as an oilseed crop which is grown throughout the semiarid region of the temperate climates, and it's comprising two main oil type: linoleic and oleic (Dorlas and Sioulas, 2008). The fatty acid composition of seed oil is the major factor determining its quality. Oleic acid is a monounsaturated fatty acid and also known as Omega-9. Oleic acid-rich oils are mostly preferred as cooking and frying oils because their specific gravity is lighter. The advantages of oleic acid-rich oils to linoleic acid-rich oils are as follows; long shelf life, high stability, better resistance to oxidation, better frying oil properties, a higher number of uses, leaving less residue (Baydar and Erbas, 2014). Because of these reasons, oleic acid-rich oils preferred more. Diversification of plant fatty acids according to their intended use also provides an advantage in terms of cultivation. The development of safflower lines rich in oleic acid in the mid-1960s made the safflower plant also a good alternative edible oil plant (Knowles and Hill, 1964). Safflower genetic improvement has been spectacular because in mid-1970, the oil content was 15% and it is increased by up to 50% just in 30 years (Gupta, 2016). Safflower seed production fluctuates according to crop rotation needs,

relative market value, water availability, abandoning cultivation due to diseases and pest, and other production constraints.

As can be seen in Table 1, World safflower production reaches up to 949.336 tons in 2016, and production is decreased to 627.653 tons in 2018.

Table 1. *2014-2018 safflower production in World*

	2014	2015	2016	2017	2018
Africa					
Area harvested (ha)	30.682	33.171	33.416	34.773	35.588
Yield (kg/ha)	645,2	648,9	675	6.859	696,2
Production (tonnes)	19.796	21.525	22.554	23.849	24.775
Americas					
Area harvested (ha)	189.178	237.027	207.511	129.880	124.798
Yield (kg/ha)	1280	1064,2	1313,1	1292,1	1.552,4
Production (tonnes)	242.142	242.142	272.487	167.811	193.734
Asia					
Area harvested (ha)	547.923	534.052	488.147	638.849	458.578
Yield (kg/ha)	692,7	731,8	739,5	682,2	794
Production (tonnes)	379544	390797	360991	435826	364.101
Europe					
Area harvested (ha)	119.783	243.827	435.830	155.719	67.441
Yield (kg/ha)	716,1	644,6	661,8	680,9	595,4
Production (tonnes)	85.779	157.168	288.436	106.034	40.152
Oceania					
Area harvested (ha)	8.893	8.393	8.353	8.521	8.425
Yield (kg/ha)	579,4	577,9	582,8	581,7	580,6
Production (tonnes)	5.152	4.851	4.868	4.957	4.892
World					
Area harvested (ha)	896.458	1.056.471	1.173.258	967.742	694.830
Yield (kg/ha)	817	782,4	809,1	763,1	903,3
Production (tonnes)	732.412	826.596	949.336	738.477	627.653

Source: (Fao,2020)

More than half of the world's safflower production is produced in the Asian continent. Kazakhstan is the most important safflower producer country in the

world with a production of 214.149 tons, and it is followed by the United States of America, Mexico, India and Turkey (Table 2).

Table 2. World's Top Safflower Producing Countries (2018)

	Country	Production (tonnes)
1	Kazakhstan	214.149
2	United States of America	107.220
3	Mexico	58.675
4	India	55.000
5	Turkey	35.000
6	China	32.950
7	Argentina	27.839
8	Russian Federation	25.259
9	United Republic of Tanzania	15.591
10	Spain	14.777

Source: (Fao, 2020)

Many safflower genotypes with different characters are used worldwide (Table 3). Except for the Middle East, spiny safflower is mostly grown. It has several reasons. Firstly, spineless variety is more susceptible to diseases and pests. Latter, bird watching is more important on spineless variety because it gets more damage by bird, and If the plant is used as cut flower or dyeing than spineless varieties getting important. the spiny variety is more drought-tolerant. Also, it has a higher oil content (Erbaş and Baydar, 2017).

Table 3. *Distinguishing characteristics of safflower from different centers of similarity*

Region	Height			Branching			Head Size			Spines		Flower Color			
	Sh	**Int.**	**Tall**	**Few**	**Int.**	**Many**	**Sm**	**Int.**	**Large**	**Sp**	**Spls**	**r**	**o**	**w**	**y**
Far East			+		+			+		**1**	**2**	+			
India Pakistan	+					+	**1**	**2**		+		**3**	**1**	**2**	
Middle East			+	+				**1**	**2**		+	**1**	**2**	**4**	**3**
Egypt		+		+				**2**	**1**	**1**	**2**	**4**	**1**	**3**	**2**
Sudan	**1**	**2**			+		**1**	**2**		+			**2**		**1**
Ethiopia			+			+	+			+		**1**			
Europe		+			+			+		**1**	**2**	**2**	**1**	**4**	**3**

Abbreviation Sh: Short, Int: Intermediate, Sm: Small, Sp: Spiny, Spls: Spineless, r: Red, o: Orange, w: white, y: yellow, 1-4: most-least, **Source: (**adapted from Knowles, 1969**),**

3. Safflower production in Turkey

First safflower cultivation in Turkey began in 1930 by immigrants from Bulgaria who bring spiny type safflower seeds in the Marmara region (Serim et al., 2015). The first variety was registered in 1931 under the name "Yenice", and it was developed through selection breeding. Afterward, Dinçer variety was developed in 1977 and Remzibey-05 variety in 2005 (Koç et al., 2010). Nowadays, there are 14 registered safflower varieties. Until 2007, small-scale safflower production was realized, for the first time this year, the production area of safflower was over 1,000 hectares. Thanks to government support and policies, safflower production gradually increased. Other reasons, safflower is a good rotation plant in arid region, and its root can reach 2.0-2.4 m depth, also all the tools and equipment used in cereals are also used in safflower production. In Turkey, as in world production of safflower, production fluctuates. When the data of the last 5 years are examined, it is seen that the production, which was 70.000 tons in 2015, decreased to 21.883 tons in 2019 (Table 4). The most important reasons for this decrease can be listed as follows: the end of government supports for safflower cultivation, sowing in stony and mountainous areas that are not suitable for agriculture, and subsequent low yield and diseases, crop rotation, decrease in safflower seed purchase prices, safflower oil is not accessible to consumers, the consumer is not familiar with the quality and use of the oil, farmer does not know the plant, and the technical support is insufficient, not having any licensed herbicides.

Table 4. *2015-2019 safflower production in Turkey*

Turkey					
	2015	**2016**	**2017**	**2018**	**2019**
Area harvested (ha)	42.793	39.352	27.376	24.693	15.859
Yield (kg/ha)	1640	1470	1830	1420	1380
Production (tonnes)	70.000	58.000	50.000	35.000	21.883

Source: Turkish Statistical Institute (TUIK)

Among the varieties available in Turkey, only "Yenice" variety is spineless, and all other varieties are spiny (Table 5). The first developed variety oil content was 28%, today's newly developed varieties oil content increased by up to 41%. Despite this increase, the rate of oil content in safflower is behind the world level, and safflower oil improvement investigation should increase.

Table 5. *Some morphological characteristics of cultivated genotypes in Turkey*

Genotype	Flower colour	Spines	Plant height (cm)	Oil content (%)
Asol	Yellow	Spiny	63-120.3	36
Balcı	Yellow	Spiny	70-100	41
Dinçer	Orange	Spiny	90-110	32
Göktürk	Yellow	Spiny	51.2-92.0	35.7
Hasankendi	Yellow	Spiny	61.5-120.5	36
Linas	Orange	Spiny	85-90	38
Olas	Yellow	Spiny	70-80	40
Olein	Red	Spiny	78.5-88.8	32.9
Remzibey-05	Yellow	Spiny	60-80	35
Safir	Orange	Spiny	79.3-90.0	34.7
Yekta	Yellow	Spiny	-	35.3
Yenice	Red	Spineless	100-120	28
Zirkon	Orange	Spiny	76.0-108.8	34
BDYAS-9	-	Spiny	82.9-96.3	37.6

Source: Republic of Turkey ministry of agriculture and forestry variety registration and seed certification center (TTSM, 2020)

4. Breeding goals in safflower

Safflower is a diploid plant with 12 chromosome pairs. Although self-pollinating prevails, the rate of outcrossing may vary depending on environmental conditions and genotype. Genetically controlled flowering interacts with genotype and day length. High temperatures can accelerate flowering (Weiss, 2000).The most important improvement purposes in safflower; high seed yield, earliness, low husk ratio and high oil content, high linoleic and high oleic acid in oil, plant type suitable for machine harvesting, resistance to adverse environmental conditions and important diseases and pests (Ashri and Knowless, 1960; Rudolphi et al., 2008). The outcrossing rate of 5-10% can occur with bees.

The main objectives in research on safflower:

1-development of hybrid varieties,

2-high seed yield

3-increasing the oil ratio,

4-reducing the husk rate,

5- resistance to disease and pest (Sing and Nimbkar, 2016)

The oil ratio of registered safflower varieties in our country varies between 25-35% (Babaoglu and Guzel, 2015). In general, both seed yield and oil ratio of thorny varieties are higher than those without spiny.

a) Seed yield

The three most important selection criteria determining the seed yield in safflower; the number of capitulum per plant, number of seeds in the capitulum and the unit seed weight (Singh et al., 2004). High-yielding plants can be obtained with the selection made especially considering the number of capitulum in the plant and the number of seeds in the capitulum. The ideal safflower type is desired to be 60-80 cm long, matured in 130-150 days, and with 12-14 well-developed capitulum on 6-8 branches. It is also preferred that the husk ratio is low, oil and high protein. (Baydar and Erbas, 2014). One of the most important selection criteria for earliness is the shortness of the rosette period. The varieties with short rosette period are not only earlier, but also have a strong competition with weeds (Baydar and Erbas, 2014).

b) Oil content in the seed

The improvement in oil content causes an increase in the oil yield to be taken from the unit area. The oil content of safflower seeds without husk is mean 60%. The oil rate of seeds with husk varies between 25-37% (Baydar and Erbas, 2014; Babaoglu and Guzel, 2015; Matayev et al., 2019). There is a close relationship between the high oil content of safflower and its fine seed husk and spiny properties. Genotypes with thin husk and spines contain higher oil than genotypes with thick husk and no spiny. There is often a negative relationship between the oil rate and seed yield in safflower. Genotypes with high oil content generally have lower seed yields (Nie et al., 1993; Singh et al., 2004).

c) Fatty acid compositions of seed oil

In general, safflower seed oil consists of 6-8% palmitic acid, 2-3% stearic acid, 16-20% oleic acid and 71-75% linoleic acid (Velasco and Fernandez Martinez, 2001; Golkar, 2014). In safflower improvement studies, both increasing the low oil content and changing the classical fatty acid composition are emphasized. The others than Remzibey among safflower varieties registered in Turkey contain high linoleic acid (75-80%). However, the new trend in the world is to develop safflower varieties containing high oleic acid.

In safflower, fatty acids are controlled by a gene pair (*OI* / *oI*). *OI / OI* allele gene pair are responsible from the high linoleic acid (75-80%) / low oleic acid (10-15%) content. On the other hand, the *oIoI* allele gene pair was responsible from low linoleic acid (12-30%) / high oleic acid (64-83%) content (Baydar and Erbas, 2014). As in other oil plants, as oleic and linoleic acids are produced by desaturation of each other on the same synthesis in the synthesis of fatty acids, strong and negative relationships arise between them, especially as the air temperatures increase after flowering, oleic acid synthesis is encouraged against linoleic acid. In addition, the first flowering capitulum in a safflower plant contain higher oil and linoleic acid, lower oleic, palmitic and stearic acid than the last flowering capitulum.

d) Spiny / spinelss types

Generally, there are a spiny crop with many sharp spines on the leaves and bracts in most genotypes of safflower (Bradley et al., 1999). Spiny is an important type feature in safflower. Many varieties with and without spines are cultivated in the world.

In varieties without spiny, these organs are completely naked or very sparse. Spiny varieties are more resistant to bird damage as well as drought**.** It is reported that safflower varieties without thorn are more tolerant of wilt diseases. The inheritance of spiny in safflower is simple, and the genes that control the formation of spines are dominant over the genes that control the spineless. However, some safflower genotypes can be spiny at different levels. Four different genes "Sa, Sb, Sc and Sd" play an active role in determining the level of spiny. Especially Sa gene plays a dominant role in the formation of spines (Golkar et al., 2010).

e) Flower color

Flower color is an important variety feature in safflower. Safflower genotypes are morphologically grouped mainly according to spiny condition and flower colors. Seven different flower colors were determined in safflower. However, flower color changes according to budding, flowering and ripening stages. There are four dominant genes (Y, C, O, and R) in the formation of flower color in safflower (Narkhede and Deokar, 1990; Baydar and Erbas, 2014). Safflower is generally divided into four classes according to the color of the flower:

1-Yellow in bloom, turning to red on drying (Y-R)

2-Yellow in bloom, turning to yellow on drying (Y-Y)

3-Orange in bloom, turning to dark red on drying (O-dark R)

4-White in bloom, turning to white on drying (W-W) (Singh and Nimbkar, 2006)

f) Resistance to environmental stresses (cold and drought)

Tolerance to environmental stresses plays an important role in increasing safflower yield in different eco-geographical climates (Golkar, 2014). In general, safflower can be grown for summer in regions with long and hard winter seasons, and for winter in temperate climates. Although classical safflower varieties can withstand temperatures down to -7^{o}C in the rosette-leaved stage, they suffer greatly from frost damage even in the passage areas where winter cold is relatively low. The rosette stages of the cold-resistant winter safflower varieties are longer, the rosette leaves are deeper on the ground and the color is darker, and the head and leaves are spinier. However, the husk rates and linoleic acid ratios are higher, and the oil and oleic acid ratios are lower than the summer varieties. Since their yields are higher than summer varieties, their oil yields/

unit area are often higher. Registered safflower varieties in our country are not resistant to cold and frost; They suffer greatly during the harsh winter months of the continental climate. For this reason, safflower is grown outside the regions where the Mediterranean climate is effective, but only for summer. Thanks to its deep root structure (its roots can go up to 3m deep), safflower is a very tolerant plant to drought and heat. In general, summer varieties that keep the rosette period short and show faster growth and development in the rainy and cool days of the spring, have high water use efficiency, and mature without suppressing dry and hot summer days, they are less likely to seek less than drought. The drought resistance of prickly, early and short varieties is higher than non-thorn, late and tall varieties.

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Chapter 9

TURKISH AGRICULTURE AND CONTRACT FARMING IN AGRICULTURAL MARKETING

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1.INTRODUCTION

It is an important deficiency that the agricultural sector is seen as an occupation that meets the food and other agricultural-based necessities of the country's population by engaging in only plant and animal production activities, and allows the export of surplus. Agriculture must first of all meet the food needs of the country's population. Agriculture must create a surplus to contribute to the foreign exchange demand required for imports. Agriculture, which also undertakes the transfer of capital and labour to other sectors of the economy, should also create a demand potential for industrial goods produced in the country. Thus, the agricultural economy in Turkey; is a sector that maintains its importance in terms of population and employment, nutrition, agricultural production, domestic consumption, contribution of agriculture to industry, national income and balance of payments.

Turkey has a rich agricultural potential has, in terms of its geographical position, climate structure and product diversity. However, failure to register production, inability of producer organizations to be active enough, unstable agricultural policies and unplanned production models cause significant problems in the sector.

The total surface area of Turkey is 783 577 km^2, in other words, 78 million hectares. When dams and natural lakes are excluded, the remaining area is 769,600 km^2. More than half of Turkey's surface area is covered by mountains (Rehber and Vural, 2018). Turkey's total agricultural area is 37.817 million hectares (approximately 38 million hectares). While the total agricultural area was approximately 41 million hectares in 2001, it was approximately 38 million hectares in 2018. Approximately 3 million hectares of agricultural land has been reduced in the last 17 years. The agricultural areas between 2001-2018 are given in table 1. No change has been observed in the field of ornamental plants. The latest statistics for the meadow and pastureland area is 14,617,000 hectares for 2001.

In the early years of the Republic of Turkey, the country was a complete agricultural country economically and socially. As a matter of fact, it is known that 2/3 of the national income was obtained from agriculture in 1927. Especially after 1960, the share of agriculture in national income has decreased rapidly and it has decreased to single digits in the last 10 years. According to the data of 2017, the share of agriculture in national income decreased to 6.1%, while the rate of population employed in agriculture is 19.40%. In 2018, the rate of those employed in agriculture increased by 0.03% to 19.70% (Rehber and Vural, 2019). These data are an indication that the share of agriculture in national income is gradually decreasing compared to other sectors, in other words, while the share of other sectors in national income is gradually increasing, there is a contrary development for those working in agriculture and therefore in agriculture.

Agricultural sector's placement in foreign trade is examined based on the years 2002-2018. With industrialization, it is seen that the share of agriculture in foreign sales has gradually decreased. Despite this proportional decrease, exports and imports of agricultural products increased in value. While the export share of agriculture is gradually decreasing, it is seen that the share of imports is gradually increasing.

In Turkey which is self-sufficient in agriculture for the first time in 2000 agricultural export-import balance was negative and this difference reached the highest value in 2017. It should be realized that our country has a rich potential in terms of climate diversity and conditions. In the coming years, the serious difference between exports and imports should be closed with correct agricultural policies. Otherwise, Turkey will be dependent on imports. The development of a country's economy is achieved not by importing but by producing.

Turkey carries positive characteristics in terms of geographic and economic structure of agricultural production. It has an important place in world agriculture, not in terms of animal production, but in terms of crop production. Turkey's hazelnut, cherry, quince, apricots and figs ranks first in World production (Rehber and Vural, 2018). It is also at the top of many vegetable and fruit types. Turkey must not only produce the products that we are at the forefront of production, but also develop our industry depending on these products. Thus, the country can have a say in the products it produces globally.

The product with the highest production share is hazelnuts with 67.08%. The second country in hazelnut production is Italy with 131,281 tons. Among the products that we rank first in world production, the second place in fig belongs to Egypt with 177,135 tons. The second country in apricot is Uzbekistan with 532,565 tons.

Businesses have searched for new marketing techniques because of the economic crisis in the world economy in the early 70's and the inadequacy of old marketing techniques in trade. Difficulties in raw material procurement in food industry especially in developed countries, *have* accelerated the development of new marketing techniques.

In this period; while marketing choices like producer markets, auction systems, cooperatives, boards have failed to satisfy, new and emerging marketing techniques *has* increased in importance.

Generally, new and emerging marketing identify with contract farming. Excessive price fluctuations in crisis years/periods affect adversely vendors and purchasers, so new methods become crucial. It occurs supply and demand fluctuation as monthly, seasonal, yearly on agricultural products cause of its structure. Excessive fluctuation affects adversely both vendors, purchasers and consumers; therefore it affects the whole of the national economy.

Price fluctuation destabilisations producer and consumer equilibrium. Producers are undecided about which product to produce. Also; decreases in

supply, has a negative effectt on market equilibrium. Government supports become important on this point, but equilibrium can't get better entirely.

Present and future marketing knowhows information underlie the sales policy for every business. Producers honor in accordance with the domestic and foreign terms of sale in their economic avtivities. Nowadays, preparing sale programmes and looking forward are seen as the key parts of the marketing management. From this point of view; contract farming which provides producers hassle-free marketing of product following the harvesting. increasingly become crucial.

Livestock in Turkey has an important place in the general economy and in the agricultural sector and potential. Animal production activities include the assessment of some herbal and by-products, the increase of labor productivity, the increase of the operating profit, the reduction of the risk factor arising from the natural and economic conditions, at the macro level, to provide adequate and balanced nutrition of people, to increase national income and employment, to provide raw materials for meat, milk, textile, leather, cosmetics and pharmaceutical industries, to reduce and prevent open and hidden unemployment in rural areas, socio-economic tasks of vital importance in Turkey is also included.

Turkey animal husbandry in terms of natural resources and ecological conditions are very favorable. However, wrong policies followed prevented the development of livestock and there was a decline in the sector. As a result, the number of animals decreased, product prices increased and people become less consume less animal products (Saçlı, 2007).

Animal husbandry has become an integral part of the economy. This suggests that agriculture and therefore animal husbandry is a strategic sector that needs to be developed at national level. Animal production in Turkey comes after crop production. The basic reason for this; because animal husbandry is not perceived as a commercial activity. Vegetable production is the primary production activity in traditional agricultural culture.

2.SIGINIFANCE OF CONTRACT FARMING IN AGRICULTURAL MARKETING

Marketing organization or marketing man wants to guarantee continuity and certain amount of product to conduct marketing activities successfully. Middleman and intermediary firm make various agreements with producers to completely actualize this marketing service which is called function of supply. Producers get the guarantee of selling their own products owing to the agreement which is called "Contract Farming".

Marketing of products start with harvesting, supplying and go forward with standardizing of product, its quality control and pachaging. The other services of marketing are transportation, storage, to guarantee of product, price formation, selling and to generate demand. All these marketing services requires knowledge and experience; and they increase the sales. While product sale and quality could

be increased with planned and well organized service network; in the contrary case, product could remain unsold even if it is good. On the other hand, this services cause failure of marketing service based on cost increase. Producers have an agreement with various merchant and firms, harvest and delivery of products; it causes both reducing marketing costs and increasing product quality.

Private companies, public institutions and cooperatives follow different methods in supply of goods from producers in Turkey. Private companies generally attend to supply goods by advanced money or provide input to producers. Conditions are determined with both verbal and written agreement. Public institutions agreement with prodecers are both verbal and written too. Producers who are the members of cooperative, must give all of the products to cooperatives. But in our country, being a member of cooperative doesn't impose an obligation to delivery of products to cooperatives. For this reason, producers don't deliver their products in most instances and cooperatives supply function can't completely actualize.

Businesses which can completely manage the supply function in principle and provide production flow from producer at the right time, have an impact on price fluctuations owing to bargaining power on market.

Altough private companies have marketing power in our country; cooperatives can't have sufficient supply of goods and the bargaining power which impact on market price, because they generally don't have an agreement based on the contract with member producers. Cooperatives whose goods appraised by goverment purchasing, manage to do supply service only if it quotes high price.

3. SAMPLES OF CONTRACT FARMING

Contract farming which is the developing marketing system, contains two types of agreement (Abbott, s.125);

1. Preproduction Agreement
2. Harvest Agreement

In prepoduction agreement, producer accept to pay by determined unit weight and sale amount is included in contract. Producer only have production risk, the risk of sale belongs to receiver (wholesaler, processor, etc). Determining details carefully, fulfillment of responsibility, is for the benefit of both sides.

Although, when daily price is too high in accordance with the contract, producers usually sell a major part of product to a third person with high price. Contrary to this situation; when market price is low, receivers quote a low price for poor quality to try to grow profit margin.

The difference between harvest and preproduction agreement, is making an agreement after production in harvest agreement. It is a sales method especially preferred on fruit and vegetables. Generally, receiver takes over harvesting from

producer. The receiver also undertakes a yield risk when being a gypsy moth on a tree. However, this method is important for consumers by the reason of regular and healthy harvesting from recievers; growers responsiblity get lighter.

Both types of agreements, decrease negativeness existing in other sales methods in free competition market, therefore it is preferred from some producers regularly. Also, some problems of contracted sales could be reviewed and solved in the following period from parties.

Making a contract with producers is the same in principle, however it varies from producer to producer. This differences results from varied producer characteristic, production techniques, harvest season and harvest methods in region.

Classification of different type of contracts by pegging as follows (Vural, 2020);

1. Contract of fixed price
2. Contract of added cost
3. Contract of considering market price
4. Contract of undetermined price

1. Contract of fixed price

The structure of producer and reciever determine the firm price. In this method, risk transfers from producer to receiver.

2. Contract of added cost

Producer's production expense is calculated. Sale price determined by adding profit share to the calculating amount.

3. Contract of considering market price

Producers have the opportunity to change the market price because of the change in supply and demand. Prodecers have the profit advantage with high-grade production in this method.

4. Contract of undetermined price

In this method, producer is exposed to the risks of price changes. However, his/her products are under purchasing guarantee at least.

This types of contract show us; how to create the mechanism of overcoming the difficulties when insufficient product supply eists which results from suboptimal weather conditions.

4.CONTRACT'S TOPIC SUBJECTS

Becoming widespreadof contract farming primarily hinges upon large mass of producer's attention. Besides, attention should be paid to preparing different

types of agreement articles for each product if required. In this chapter, we study on the meaning of some important contract articles.

Handbuilt and informal agreements cause disutility in legal demand for producers. Advocacy service become important in this respect. Producers and receivers should have chance to use their potential completely by consulting to lawyers.

The contract includes firstly organizing between which producers and firms, place and time; secondly rundown about parties and thirdly details of contract. Articles of agreement is determined by characteristic of product. By means of agreements which are previously done; input allowance is made, products are received, price is fixed and payment is made.

Nowadays, contract production is quite prevalent in some regions of our country. However, it confronted with big problems; firms couldn't receive products they want, producers complain about low price and deferred payment.

When price is lower than contract price; producers who don't make an agreement, could sell their products to contract producer and they cause overpayment of factories. It occurs surplus goods in factories. Otherwise, when market price is higher than contract price; somme of the producers avoid from carrying out their commitment to factories.

In addition to meat and milk prices, feed prices should also be carefully analyzed as the most important inputs after the livestock activity. The balance between product and input prices should be at a level where the producer will not give up production. However, a sustainable production can be mentioned at this level. For this purpose, milk/feed and meat/feed parities are important indicators in terms of establishing the situation of producers.

Turkey in the livestock sector; small scale of enterprises, scattered and inadequate capital, limited demand in animal products and depending on the number of vehicles in marketing system; it is inevitable that the producers should be organized for reasons such as the inability of the products to be marketed at appropriate times and prices, the product and input prices to be created in an environment where the producers are not active, the inadequacy of education and broadcasting services and the inefficiency of the producers to use information and technology. In Turkey; the fact that the importance of the organization is not well known by the producers has led to the backwardness of the agricultural producers in organizing; the level of organization today is only 40% (Saçlı, 2007).

Turkey agricultural product markets in general; is the superiority of those who have the middleman to market. Thus; the intensity of the hand-over of the product which is about 6-7 as the final consumer from the producer to the animal product; 4-5 levels of herbal products (Kıymaz ve Saçlı, 2008). On the road extending from producer to consumer; intermediary persons and institutions

engaged in marketing; village collectors, animal traders, commissioners, celebs, nourishers, exporters, manufacturers of meat products and retailers butchers.

The number of small-scale, scattered, marketing agencies such as village collectors or celeps who collect pets by collecting animals from a large number of traditional farming establishments is high; marketing services are quite low. This situation increases the cost of marketing. The fact that production and consumption centers are more than one each other causes the number of middleman.

Not having enough information about the businesses and informality is a major problem. The impossibility of evaluating the results of the policies implemented; it is a barrier to the formation of correct policies. Factors such as having small and insufficient capital, low yield per animal, inadequacy of meadow and pasture areas, high feed prices, market dominance, fluctuations in product prices and so on are important obstacles for the industry.

5.CONCLUSION AND RECOMMENDATIONS

Nowadays, contract production is quite prevalent in some regions of our country. However, it confronts with big problems; firms couldn't receive product what they want, producers complain about low price and deferred payment.

When price is lower than contract price; producers who don't make an agreement, could sell their products to contract producer and they cause overpayment of factories. It occurs surplus goods in factories. Otherwise, when market price is higher than contract price; somme of producers avoid from carrying out their commitment to factories.

In order to succeed in implementation, producer and businessman require to determine the conditions of contract with face to face discussion. For this purpose, The Union of Turkish Agricultural Chambers which isthe legal represantative of producer, should help to producer to prepare an agreement. Producers should collaborate with agricultural chambers for the signing of contract, contract should be signed by agricultural chambers, if needed.

Firms should pay attention to producer's opinion of quoting of a product price; price fixing should be determined by the committee which consist of , The Union of Turkish Agricultural Chambers and Ministry of Food, Agriculture and Livestock.

Some inconveniences occur in paying the product price. If recovery of debts are postponed, penalty rate should be performed. In what way and when making a payment to producer and payment conditions must be in the contract. The articles should be removed which conducivve any dispute.

Mechanism of suretyship in group should be managed strictly in the region where agreement is made. Thus, when producers do anything which is not

included in the contract, everyone is responsible for it. In this circumstances, firm's control action increases.

Doing business operation is based on trust. However, abovementioned subjects should be express clearly in contracts. The price which producers get due should be in contract; problems of delivery and payment should be tried to minimize.

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