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Organic goat production, processing and marketing: Opportunities, challenges and outlook☆

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ABSTRACT

Organic goat production can be a rewarding livelihood and is gaining popularity. Global organic production has increased significantly annually over the past decade. Industry analysts forecast that demand in many markets will continue to grow at 10–30% per year, with the international organic market expected to grow to a volume of US$ 100 billion in the next decade. Organic dairy has shown stronger growth rates than organic meat production. In certain regions, the rise in organic milk production has increased the range of processed value-added organic milk and dairy products, and demand is out-stripping supply. The basic principles of organic goat production include care, ecology, fairness, and health as stated by the International Federation of Organic Agriculture Movement (IFOAM). Organic goat production can improve animal welfare, protect the environment, and sustain rewarding rural live styles. There are challenges when dealing with organic goat production, especially when one hopes to control intestinal parasites and to achieve adequate nutritional management. Exploring nutritional technology and disease prevention and treatment will eventually improve the production efficiency. There are various regulations in different countries that apply to certify organic foods, and the number of regulations is growing. One of the leading federations in international organic farming is IFOAM. The standards can be certified under IFOAM then can be recognized in many counties around the world. These regulations serve as branding effort, not only to protect the "organic" brand but also to promote it. Future of organic goat production will have to rely on continue search for alternatives in nutrition and disease prevention and control that are environmentally friendly, human health conscientious and animal considerate. Understanding organic goat farming from economic, ecological, and animal welfare perspectives will increase the likelihood of success.

1. Introduction

Can organic goat production be the answer to the concern of sustainability, animal right, environmental preservation, and rural economic vitality? Consumers increasingly view organic goat production as the appropriate way of both farming and rural living. Organic farming is a growing business. Producers and consumers alike do not necessary understand the challenges of organic

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goat farming from an economic, ecological, or animal welfare perspective. People new to the business often downplay the nutritional, health and labor problems commonly associated with organic farming, but they could also overestimate the marketing and production potential. Generally, to acquire expertise on operation and management of organic goat and sheep farm may take several years. In addition to patience and persistence, skills such as marketing ability, animal management, qualified veterinary and professional advice and support are essential for successful organic goat farming (Lu and Gangyi, 2008).

Values in animal welfare, environmental preservation, product quality have been increasingly viewed by consumer and producers as important consideration for producing and consuming agricultural products. Milk, meat and fiber produced from goats organically may be viewed positively under these values (Lu and Gangyi, 2008).

2. History and development

Beginning roughly 10,000 years ago, Neolithic farmers in the Near East started keeping small herds of goats for both their meat and milk, as well as for clothing and building with the hair, bone, skin and sinew. Undoubtedly, goat farming at the time was organic. Mechanical (1880–1930) and chemical (1920–1950) revolutions in agriculture greatly influenced the modern day livestock farming predominately in non-organic form. Biological advances in the genetically modified organisms in the 70s further complicated the researcher–producer–consumer dynamics. As of today, there are over 750 million goats scattered throughout the world. Goats are found in nearly every country on the planet and in nearly every climate, each one with a different purpose. There are more than a thousand adapted breeds in existence. About 90% of all goats are found in developing countries; to some they are considered “the cows of the poor”.

Rudolf Steiner (1861–1925), considered one of the founders of organic farming, proposed a form of agriculture called biodynamics, drawing from cosmic and telluric forces. The concepts of humanity and living things were introduced and biodynamics drew from the Greek words of bios, meaning life, and dynamis, meaning energy. Biodynamic agriculture, or biodynamics, comprises an ecological and sustainable farming system that includes many of the ideas of organic farming, but predates the term. Biodynamic agriculture emphasized the individualization of the farm by bringing in no or few outside materials. The degradation of the quality of food was attributed to chemical farming, artificial fertilizers, and pesticides. The quality of food produced was considered affected by spiritual shortcomings and believed the world and everything in it was simultaneously spiritual and material in nature, an approach termed “monism”.

Modern day organic farming began to emerge in 1950s with major developments taking place in the 1970s. Creation of certification bodies occurred in the 1980s. In the 1990s popularity soared. Biodynamic was introduced in 1924. Rodale Farm in the US is the first modern day organic farm, established in 1947.

Global turnover for organic farming was reported to be US$ 40 billion in 2006 (Willer and Youssefi, 2007). It has grown 20% annually over the past 10 years. Demand in many markets will continue to grow at 10–30% per year according to industry experts. The international organic market is expected to grow to a volume of US$ 100 billion in the next 10 years. According to the Organic Trade Association, total U.S. organic sales, including food and non-food products, were estimated to have reached $21.2 billion in 2007, and were projected to surpass $25 billion in 2008. The Organic Monitor expected international sales to reach $38.6 billion in 2008 (Foreign Agriculture Service, 2008). Sixty-nine countries have a regulation on organic agriculture, while 21 are drafting one (Huber, 2008). There are currently more than 468 certifiers in the world. A recent and significant development in organic agriculture is the increase in wild collection.

3. Global organic agriculture

Land area for organic agricultural production by continent is the largest in Australia/Oceania with 12.4 million ha, and the smallest in Africa with 0.4 million ha (Willer and Youssefi, 2007). Continents with high demand for organic products such as Europe and North America have 7.4 and 2.2 million ha of organic land, respectively. Relatively low land area for organic production in Africa and Asia represents opportunity for growth in organic agriculture and can become an alternative production system that promotes rural prosperity and alleviates poverty in these regions. Organic agriculture production in Latin America grew rapidly in the past decade, reflecting a growing demand in the export markets. Percentages of number of organic farms by continent are 32, 28, 24, 13, 2 and 1 for Latin America, Europe, Africa, Asia, North America and Oceania, respectively (Willer and Youssefi, 2007). Although Oceania leads the organic land area, it is the smallest in terms of number of organic farms. Latin America, Europe and Africa combined have 84% of organic farms in the world.

Australia is the leading country in organic land area, with more than 12 million ha, followed by China (2.3), Argentina (2.2), US (1.6, 2005 data), Italy (1.1), Uruguay (0.9), Spain (0.9), Brazil (0.9), Germany (0.8), and UK (0.6) (Willer and Youssefi, 2007). Liechtenstein is the leading country with highest share of organic land (29%), followed by Austria (13%), Switzerland (12%), Italy (9%), Estonia (9%), Greece (8%), Portugal (7%), Sweden (7%), Latvia (7%), and Timor Leste (7%). In terms of land use in organic agriculture, permanent grassland represents more than 60% globally, implying the significance of organic livestock production. Arable land, permanent crops, cropland, and land without information of use make up the rest.

There has been an almost continuous increase in organic agriculture, as reflected in the increase of organic agriculture land from less than 7 million ha in 1998 to more than 30 million ha in 2006 (Willer and Youssefi, 2007). Another significant development is the increase in wild collection land, from almost zero in 1998 to more than 33 million ha in 2006, and still increasing. Some lands were not intentionally managed as organic, but qualified to be organic because

no chemical fertilizers and pesticides had been used on them previously. This development is particularly significant in extensive livestock production, including goats. It provides a rapid transition to organic production and expands opportunities for farmers in marginal land areas.

With the exception of North America, every continent experienced an increase in organic agricultural land from 2005 to 2006, according to the most recently available data (Willer and Youssefi, 2007). In Europe organic agricultural land increased by more than 7400% within two decades, implying a rapidly maturing industry with growing consumer demands in organic agricultural products. Most of the land used for organic agriculture in developing countries is permanent grassland, more than 50%, followed by crop land with no details (12%), permanent crops (9%), and arable land (8%). Four continents roughly share the same proportion of organic wild collection globally: Europe (28%), Africa (25%), Asia (24%), and Latin America (22%). North America is the only continent with a small share of wild collection, 1.3%. Latin America is a growing region for organic agriculture. In Colombia, organic agricultural land increased from 25,000 ha in 2002 to more than 55,000 ha in 2007. In Bolivia, export market of organic agricultural products grew from insignificant in 1995 to just below 10,000 ton in 2005, with an increase in total organic production from less than 1000 ton to more than 20,000 ton in the same period.

Data on organic goat production is scarce. Greece leads goat production in the European Union, with 37.2% of total goat population in Europe, followed by Spain (21.6%), France (9.4%), Italy (6.9%), and Romania (6.5%) (Ataide Dias et al., 2008). While total goat population remains relatively unchanged or with a slight decrease for the past two decades in Europe, there is an upward trend in Romania since 2005. Number of goats in organic production grew rapidly in Greece form just over 50,000 in 2002 to almost 300,000 in 2005 (Eurostat, 2007). Organic goat production has modestly increased or fluctuated in Italy and Spain, with France maintaining a fairly stable number since 2001. Percentage of goats in organic production is the highest in Italy, about 9%, followed by Greece, France and Spain (Eurostat, 2007). Martini and Lorenzini (2007) listed varieties of organic products from dairy sheep and goat production systems in the Mediterranean area and indicated the economic importance of organic goat farms in Southern Europe.

EU-15 certified sheep & goats amounted to 2.4 million heads or 2.4% of total sheep and goats herds (European Commission, 2005). Significant shares of EU-15 certified sheep are located in the United Kingdom and Italy. Half of the certified goats are located in Greece.

4. Industry standard

One of the leading federations in international organic farming is the International Federation of Organic Agriculture Movement (IFOAM). Certified standards under IFOAM are recognized in many counties around the world. These regulations serve not only to protect the "organic" brand but also to promote it. The IFOAM is a grassroots and democratic organization that currently unites 750 member organizations in 108 countries (IFOAM, 2008). It promotes worldwide adoption of ecologically, socially and economically sound organic agricultural systems, and operates under four principles: health, ecology, fairness and care. These principles are identified to sustain and enhance the health of soil, plant, animal, human and planet as one; to work with, emulate and sustain living ecological systems; to ensure fairness in common environment and life opportunities; and to protect health and well-being of current and future generations and the environment (IFOAM, 2008). The IFOAM seal serves as an important distinction: a market-oriented mark of compliance with the IFOAM Norms; used on products that are certified by IFOAM Accredited Certifiers; and ensures wholesalers, retailers, and consumers that a product and its producer are organically certified within the IFOAM Organic Guarantee System. There are many other seals used throughout the world for similar distinctions and purposes such as USDA Organic, Australian Certified Organic, INDOCERT in India, Organic Farming in Europe, JAS in Japan, Bio Gro Organic Certified in New Zealand, BIO in Germany, and Organic in China. China has a unique system called Conversion to Organic with its own separate seal, and allows a transition period for a product to become organic. It plays an important role in encouraging conversion to organic, in the meantime, recognizes its market value (Lu and Gangyi, 2008).

One of the most important aspects of organic goat production is the certification process which means certain industry standards are compulsory. These standards may vary from country to country, although the guiding principles appear to be similar. In USA, the United Sates Department of Agriculture has a set of standards and regulations that farmers have to follow to become USDA organically certified through the National Organic Program. Across the United States many states also have an organic certification label such as the Oregon Tilth Certified Organic Program or California Certified Organic Farmers. In Canada, a set of standards was developed by the Canadian General Standard Board and Canadian Organic Advisory Board that was formed in 1992. In parts of Europe, the European Union Regulation is followed, and in Japan, producers comply with the Ministry of Agriculture, Forestry and Fisheries. China has a National Organic Standard. Mexico has passed a National Organic Products Law enforced by the Ministry of Agriculture. East African Communities have also established the East Africa Organic Standards.

Purposes of certification include: to address a growing worldwide demand for organic food, to assure quality, to prevent fraud, and to promote commerce. The process of organic certification varies from region to region, but generally includes the following steps: learning of the organic standards, which cover in specific detail what is and is not allowed for every aspect of farming, including storage, transport and sale (Study); farm facilities and production methods must comply with the standards, which may involve modifying facilities, sourcing and changing suppliers (Compliance); extensive paperwork is required, detailing farm history and current set-up, and usually including results of soil and water tests (Documentation); a written annual production plan must be submitted, detailing everything from seed to sale and including seed sources,

field and crop locations, fertilization and pest control activities, harvest methods, and storage locations (Planning); annual on-farm inspections are required, with a physical tour, examination of records, and an oral interview (Inspection); an annual inspection/certification fee (Fee); and a written, day-to-day farming and marketing records, covering all activities, must be available for inspection at any time (Record-keeping).

The definition of "organic" would include something along the lines of, not using pesticides, artificial fertilizers or any addition that mother earth does not provide the food we eat today. European eco-regulations favor renewable resources and recycling, returning to the soil nutrients found in waste products. It regulates meat and poultry production with particular concern for animal welfare and by using natural foodstuffs. It emphasizes the respect to the environment's own systems for controlling pests and disease in raising crops and livestock and avoids the use of synthetic pesticides, herbicides, chemical fertilizers, growth hormones, antibiotics or gene manipulation. It advocates the use of a range of techniques that help sustain ecosystems and reduce pollution. At least 95% of the product's ingredients should have been organically produced. The product should comply with the rules of the official inspection scheme. Products should come directly from the producer or preparer in a sealed package. The USDA National Organic program regulates the standards for any farm, wild crop harvesting, or handling operation that wants to sell an agricultural product as organically produced. It develops, implements, and administers national production, handling, and labeling standards for organic agricultural products, and accredits the certifying agents (foreign and domestic) who inspect organic production and handling operations to certify that they meet USDA standards.

5. Organic goat production

Major considerations of organic goat production include personnel, livestock (animal welfare and health), facility, management, environmental conservation, product quality and safety, and profitability. Essential elements for a successful organic goat production may include nutrition and feeding, reproduction, breeding, animal health, animal welfare, environment, plants and vegetation and workers (Lu and Gangyi, 2008).

Details of organic livestock production can be found in the USDA National Organic Program (USDA, 2008). In summary, pastures must be certified organic and maintained without the use of pesticides, herbicides, chemical fertilizers, or other restricted materials. Anything fed (hay, grain, pellets, and milk replacer) to does and kids must be certified organic. Organically grown feed cannot contain synthetic hormones, antibiotics, coccidiostats, urea, or other restricted materials. Even bedding, which may be consumed by animals, must be certified organic. Animals intended for slaughter cannot be treated with antibiotics, anthelmintics, growth implants, or other prohibited materials. Breeding stock can be dewormed only with Ivermectin® on the basis of fecal egg counts, but not on a routine or preventative basis and not during the last third of gestation or during lactation. Animals which must be treated with prohibited materials cannot be represented as organic. Vaccinations are acceptable. Records must be maintained on feed and health care. Identification of animals is required throughout the life cycle. Organically-produced animal is not the same as naturally-raised, free-range, or grass-fed (Lu and Gangyi, 2008).

National Organic Standards in the U.S. are more stringent in allowing the use of anthelmintics. While internal parasites may not be as severe a problem in animals under confinement, they are the biggest health challenge faced by goat producers. Organic standards in Europe recognize that total natural internal parasite control is difficult to achieve and generally compromises the welfare of goats, therefore, deworming of small ruminants with targeted use of anthelmintics and coccidiostats is allowed. It is generally more expensive to produce products organically in goats. The producers must recognize that organic feeds are not always readily available, and more land is generally needed.

6. Milk production

It has been demonstrated that organic dairy goat production can be productive and sustainable. Rahmann (2002) reported an annual average milk yield from 532 to 835 g/day of a herd with 20–35 lactating goats over a period of 6 years in Germany. However, the availability of forage, affected by rainfall and other environmental factors, contributed to the fluctuation in milk yield over a 6-year period. In a more recent study/survey with a larger herd over a 4-year period, Rahmann (2008) reported a milk yield ranging from 488 to 790 kg/year, or 1.6 to 2.6 kg/day for a 305-day lactation period. These reports established that higher yields are possible in organic dairy goat production, but is subject to pasture condition. Moroni et al. (2002) studied intramammary infections, milk production and quality in organic dairy goat farming and concluded that it is possible to control infections and somatic cell counts without the use of drugs and maintain production level and quality.

7. Meat production

There is no obvious difference in production efficiency or carcass quality between organic and conventional goat herds. Guzmán et al. (2008) used 24 identical twins and studied the carcass yield in Blanca Andaluza kids from birth to 8.4 kg. They reported differences in leg compactness index, offal distribution, but no difference in carcass yield and conformation. Zurita et al. (2008) studied 89 Murciano-Granadina kids from birth to 7 kg and reported a 0.5 kg difference between the conventional and organic herd. Organic goat meat production generally favors a feeding system that avoids a high energy diet with maximum weight gain. As a result, the carcass will likely accumulate less amount of internal fat around their heart and kidneys. A slower rate of gain, but heavier market weight, is therefore more advisable.

8. Fiber production

Information pertaining to organic fiber production in goats is scarce. Using a Linear Programming model to study the feasibility of introducing cashmere goats in an organic sheep production system, Eik and Asheim (2002) suggested that movements from sheep to cashmere goat production with profitability when yields of meat and cashmere could be improved by feeding the kids until 20 months (19 kg). They further suggested that benefits of high value cashmere production and biological control of weeds and brush and current support of organic farming could render organic fiber production viable in goats.

9. Organic goat production in marginal land

In a survey (40 variables in 10 indicators) of 23 farms (organic and conventional) in Andalusia marginal land areas, Mena et al. (2008) reported that conventional goat production systems lag behind organic in nutritional management, sustainable pasture management, soil fertility and contamination, veterinary care and prevention of diseases.

10. Nutritional implications in organic goat production

Nutritional implications in parasitic control in goats have been reviewed (Hoste et al., 2005b). It has been demonstrated that protein supplementation can improve resistance and/or resilience of grazing goats (Chartier et al., 2000; Eitter et al., 2000; Wang et al., 2008). This is significant, as the control of parasites and other diseases can be a challenge in organic goat production. A boost in the immune system as a result of protein supplementation can enhance the production efficiency of organic goat herds. Because of the importance in synchronization of energy and protein to achieve optimal microbial synthesis in the rumen, an optimum energy and protein interaction is important in organic goat production (Lu and Potchoiba, 1990). This can be challenging when goats are on pasture and rely mainly on grazing. Understanding of nutrition, eating behavior and seasonal interaction can also be beneficial to improve production efficiency (Lu, 1988; Torres-Acosta et al., 2000).

Secondary metabolites such as tannins and tanniferous plants have implications in organic goat production (Lu, 1992; Min and Hart, 2003; Min et al., 2005; Paolini et al., 2003a,b; Puchala et al., 2008). Trichostrongyle egg excretion in naturally infected goats was significantly less when sainfoin was included in the diet (Paolini et al., 2005). Tannin reduced fecal egg counts in goats (Paolini et al., 2003a,b). Lespedeza with high condensed tannins reduced fecal egg count and mortality rate in meat goats (Mangione et al., 2008). Effects of dehydrated neem, fresh neem, and seed extracts on fecal egg counts were inconclusive (Luginbuhl and Pietrosemoli, 2008). Heather supplementation reduced fecal egg counts in goats (Osoro et al., 2007). The authors suggested that heather availability in the vegetation might represent a valuable opportunity and sustainable method to control gastrointestinal nematode infections in a goat production systems based on grazing perennial ryegrass-white clover pastures. The effect of natural zeolite that reduced fecal egg counts had been recently reviewed (Papaioannou et al., 2005).

Legumes can be important in organic goat farming systems. It is attributed to their abilities in nitrogen fixation, increased soil fertility and stability, capacity for nutrient recycling, control of weed species, break disease and pest life cycles, high protein animal feed cash crop, biodiversity and landscape quality, and operational flexibility (Howieson et al., 2000).

Because the use of chemicals is prohibited in organic goat production, alternatives must be found to prevent, control and treat diseases. Rahmann and Seip (2006) reviewed and identified plants and plant preparation as alternative anthelmintics. The list included black cumin, black walnut, boundary tree, common mugwort, common wormwood, crucifers, custard tree, eucalyptus, Eurasian wormwood, fargara, fennel, fern, fumitory garlic, Gambian mahagony, goosefoot, Indian lilac, kamala tree, neem tree, papaya, pinkroot, pumpkin, pyrethrum, sacred basil, southern wormwood, tansy, tarragon, wild carrot, and wild ginger. Hoste et al. (2005a) reported a number of bioactive plants that could be useful for disease control and treatment. The list included a number of legumes (sainfoin, sulla, lotus corniculatus, lotus pedunculatus, dorycnium, chicory) and woody plants (heather, oak, hazel tree, brambles). These plant species can be promising in parasite and disease prevention, control and treatment in organic goat production.

Grazing management strategies are also important in the control of internal parasites and diseases. These include preventive (turning out parasite free animals on clean pastures), evasive (worm challenge is evaded by moving animals from contaminated to clean pastures) and diluting (worm challenge is relieved by diluting pasture infectivity) strategies (Barger, 1997; Cabaret et al., 2002; Eysker et al., 2005; Healeya et al., 2003; Thamsborg et al., 1999; Rahmann and Seip, 2006).

11. Product processing

During processing, organic milk is not allowed to be contaminated by chemicals. No synthetic materials that include preservatives and flavoring agents can be used during the processing of organic milk and other dairy products. It is legal to use raw milk in making cheese if the cheese is aged at least 60 days before sale (Dairy Practices Council, 1994). Fresh cheese must be made with pasteurized milk.

Organic meat cannot come into contact with non-organic meat during processing and no synthetic materials can be used during the processing of organic meat and meat products. It is important to recognize that synthetic internal parasiticides on slaughter stock are not permitted. Instead, a program based on fecal exams, culling of seriously infested animals, pasture rotation, manure management and vector and intermediate host control using allowed materials should be considered.

In many areas of the United States and the world, there are no organic processors. In some areas, a processor is available for both organic and non-organic products. It is

vital to be sure of the market demand in the area and secure a processor.

12. Product marketing

Quality, price, appearance/freshness, taste and family health are the top five considerations for purchasing food items by consumers (Eurostat, 2006). More than 40% of the consumer population identified quality and price as important consideration. In just about every member of the EU-25, more than 50% of consumers worried about the welfare of farm animals, implying consumers' willingness to pay a premium to improve animal welfare. Organic products, through their marketing channels, proclaim they are made under principles that do not pollute the surrounding environment, do not exploit the people involved in the process, and do not use pesticides. In addition, animals are bred ethically and treated well instead of exhausted, kept free range, allowed to breed well and eat freely, are well-fed and have an organic food supply, and some even claim to follow a strict "no child labor" policy. Traditional practices, market potential and resource availability should also be important considerations in the marketing of organic goat products (Lu and Gangyi, 2008).

Producers could choose not to deal with a milk buyer and hope to increase their farm profits by processing the milk themselves. Diversifying the products to include fluid milk, milk-fed pork, goat cheese of one or more varieties, yogurt, fudge, goatskins, meat, or goat-milk soap or lotions may offer more income and financial stability. It is important to recognize that organic goat production with forage feeding can produce gains comparable to grain feeding in terms of cost per unit of gain (Lu et al., 2005). A grass-fed organic goat will likely be leaner, have less saturated fat, more omega-3 fatty acids, more conjugated lineolic acid, and higher beta carotene and vitamin E. These are all attractive quality indicators for consumers and can be emphasized in marketing. However, one must also recognize that grass-fed goat meat tends to have more off flavors and is more subject to oxidation, which affects shelf life and color.

13. Organic production and food security

It has been a concern that conversion from traditional to organic production may result in a decrease in food security in terms of food availability, access, stability and utilization. Unfortunately little literature is available on the subject. Halberg et al. (2006) projected modest impacts on global commodity prices, production, and trade by organic farming. They concluded that certified organic production would decrease production and increase commodity prices in Europe and North America. However, in low-input areas such as Sub-Saharan Africa, non-certified organic farming would actually increase production, decrease prices, and improve food security slightly. It was concluded in an international conference that organic agriculture could actually contribute to global food security but its potential to do so depends greatly on political will (FAO, 2007). The conference further concluded that organic agriculture could lessen new challenges such as climate changes through soil carbon sequestration, improve drinking water quality and security through decreased irrigation needs in organic soils, increase agrobiodiversity, enhance nutritional adequacy with more diverse and micronutrient rich organic foods, and achieve rural development generating income and employment in areas where people have no alternative other than using labor, local resources and indigenous knowledge. Badgley et al. (2007) suggested that organic agriculture could sustain the food supply of the current population without increasing the land base and contribute to the alleviation of the detrimental environmental impact caused by traditional agriculture.

14. Animal welfare, ecological, and sustainability issues

Housing, handling, transport, slaughtering, disease, injury, starvation and veterinary treatment could be major considerations for organic goat producers to address consumers' concern for animal welfare. The standards for animal welfare in organic goat production are yet to be defined. Lindqvist (2001) reported results on animal health projects and concluded that animal welfare and health should be a fact in all animal farming, and maybe more in organic farming.

Tybirk et al. (2004) identified biodiversity, habitat diversity, extent and structure, functional integrity of habitats and agroecosystems, landscape integrity and accessibility as important ecological considerations for future farming. These are useful ecological perspectives for organic goat producers to consider in the future.

Ronchi and Nardone (2003) listed a number of issues related to sustainability that included landscape degradation, degradation of communal pastures, abandonment of marginal lands, low levels of integration between agriculture and livestock, land fragmentation, great dependence of farmers on purchased feedstuffs, reduced diversity and increased specialization in monocropping, numerical reduction of local breeds and populations, large incidence of parasite disease and necessity of preventive and curative chemical treatments, high incidence of clinical and subclinical mastitis, high incidence of other diseases, and high variability of milk quality. To improve sustainability of organic small ruminant production, Nardone et al. (2004) identified breeding strategies, feed management and disease control for small ruminants as important focus. They suggested that animal selection should take into consideration the relationship between animals and the environment; feeding management should strive for a spatial and temporal integration of agricultural components with livestock; and possible alternatives to chemoprophylaxis should be available to control helminth diseases, such as the use of homeopathic treatment, and the improvement of genetic resistance to parasite infections.

15. Global trend and outlook

It is generally agreed that demand for organic products is concentrated in certain parts of the world. In most instances the demand is outpacing organic food supply (Foreign Agriculture Service, 2008). Because of the pre-

mium paid by the consumers for organic products, there will be an increase in investment in organic production, although the net impact of the current economic downturn could possibly reverse the trend. In order to protect the industry, it is expected that the number of organic standards will be growing. Supply-demand imbalances are to remain in regions. Disparity between producer and consumer countries will also remain. Consumers are becoming increasingly sophisticated (Organic Monitor, 2006).

16. Opportunities and challenges

There are several opportunities that may impact the future of organic agriculture, including goat production. Grazing goats in marginal land that is organic through wild collection is promising. It can increase income of goat producers operating on these lands. Global acceptance of organic products like goat cheeses, meat and fiber is also an important opportunity for the future growth of organic markets. While energy and chemical costs are high, practicing sustainable organic goat production in general has an economic edge. Alternative medicine as a result of prohibition of restricted materials to treat diseases and illness can be promising.

A number of research opportunities are also apparent, the list include: emerging health issues, welfare and production constraints; epidemiological surveillance of key production diseases; breeding studies on disease resistance and commercial traits, nutritional deficiencies in organic systems, livestock breeding, biological control and the use of novel plants and plant extracts, development of animal welfare assessment methods, and development of welfare-friendly production systems.

Animal health and welfare, with a greater emphasis on disease control and eradication will likely be the main challenge for organic goat production in the future. In order to accomplish goals of disease prevention, control and eradication, monitoring and evaluating of alternative health products will gain importance. To capitalize on the opportunity of using marginal land for organic goat production, converting hill and upland systems to organic production efficiently will most likely be required in the future. Due to the extensive use of grazing for organic goat production, mineral deficiencies as a result of soil characteristics and pasture management system should be important considerations (Qi et al., 1993). In addition, prevention of fraud and quality assurance for organic goat dairy, meat and fiber products will continue to be a concern for consumers.

17. Conclusion

Organic goat production can improve animal welfare, protect the environment, and sustain rewarding rural lifestyles. Traditional and alternative medicine holds the promise for alternative prevention and treatment of animal diseases. The future of organic goat production is to continue searching for alternatives that are environmentally friendly, human health conscientious and animal considerate. Understanding organic goat farming from economic, ecological, and animal welfare perspectives will increase the likelihood of success. Organic goat production will have to strive for a more sustainable system than the conventional one, offsetting the increased costs of organic goat production by higher product prices, and certified organic goat products that are healthier than those conventionally produced.

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