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# USING GOATS IN AGROFORESTRY SYSTEMS TO ENHANCE FOOD SECURITY FOR SUBSISTENCE FARMERS

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## ABSTRACT

For thousands of years, goats have played a significant role in the agroforestry systems of people around the world. Their small size, robust nature and ability to eat a wide variety of feeds, from cactus to cardboard, makes them the first choice for millions of subsistence farmers, especially women, to enhance their food security and save for future expenses. Although there are many reasons why farmers choose to raise goats, this paper will focus on the impact goats have on the level of food security for subsistence farmers, and how this impact can be enhanced through the application of agroforestry principals. Such systems include silvopastoral practices, fodder banks, fodder hedgerows, and home gardens. Within these systems, goats, which prefer browse, contribute to food security as they help farmers manage risk, improve nutrition for their families, produce more value-added products and help maintain soil fertility for crops. As cities and farms expand into what was once pasture land, subsistence farmers are challenged to increase livestock productivity without expanding their grazing lands. Agroforestry is uniquely suited to help meet this challenge through the integration of goats and perennials and the production of fodder from multipurpose trees.

Keywords: fodder, small ruminants, browse, grazing, drought, risk reduction

## INTRODUCTION

While many perceive goats as having more to do with the destruction of trees than food security, the situation is more complicated than that. The role of goats in land degradation must be seen in the light of livestock management. When goats contribute to land degradation, this is a result of poor management which subsistence farmers may believe is the best of their limited choices. Goats are often present at the latter stages of land degradation precisely because good forage is no longer abundant and they are able to utilize the remaining browse which is less palatable to cattle and sheep (García *et al.* 2012). It is their preference for tree leaves, or browse, which makes goats so well suited for integration into agroforestry systems. But as in any agroforestry system, correct planning and management are critical to the creation of a system which will maintain production on a sustainable basis, and thereby enhance food security.

## GOATS: REPUTATION VS. REALITY

Goats and other ruminants have been blamed for land degradation and soil erosion around the world, often in ecologically sensitive areas like the arid highlands of North India and Pakistan (McVean and Robertson 1969). The significant role goats can play in watershed degradation

prompted one author to write that the most effective achievement of their project was the reduction in the number of goats (Swarn Lata Arya *et al.* 1994). In Africa, overgrazing has seriously eroded and degraded over 80% of the grazing lands (Pimentel 2006). Once a forest has been cut down, overgrazing by goats can effectively prevent any new trees from ratooning as goats can eat all the new sprouts from the stumps of those trees (personal observation in West Africa and Haiti). This usually results in the slow death of those stumps or trees and the local elimination of those tree species. This kind of land degradation is not caused by the goats, but by the people who cut down the trees and those who manage the goats (El Aich and Waterhouse 1999; García *et al.* 2012). To blame such degradation on goats alone is both inaccurate and misleading.

The majority of land degradation in the developing world is caused by either the farming of sloped land and/or the overgrazing of rangeland (Das and Bauer 2012; Pimentel 2006). Agroforestry systems which utilize both trees and goats are well suited to address both these causes of land degradation. The age-old conflict between farmers and herders can be reduced when both food and fodder are produced from the same land, when both farmer and shepherd are committed to growing feed for their animals. Grazing land which is transformed into farmland need not cause a reduction in food for livestock if fodder trees are integrated into the system. In fact, as populations increase, there will be a need for more of such systems to replace lost forage and maintain the diversity of food sources which is so important to food security.

Because goats are browsers, they prefer to consume leaves over grass and forbs. Depending on the season, they will consume between 50-85% browse when given the choice between browse, grass and forbs. Cattle on the other hand, when given the choice, will consume between 60-70% grass, while sheep prefer a more balanced diet of 40-50% grass, 30-40% forbs and 20-40% browse (G. Animut and Goetsch 2008; Rankins and Pugh 2012). Subsistence farmers are often limited in their choice of grazing lands, and may have to make do with poor quality forage for most of the year. This increases their preference for goats which can take advantage of good quality forage when it is available, and then consume green leaves when grass and forbs are unavailable or lacking in nutritive value during the dry season (Schacht and Malechek 1990).

## FOOD SECURITY

People have food security when they have access to sufficient food throughout the year to meet their needs and preferences. Negative events like drought or floods can produce shocks, e.g., crop failure or loss of livestock, which reduce food security. Subsistence farmers will use multiple techniques, such as diversification of assets or risk-spreading in space or time, to reduce their vulnerability to such shocks. Raising goats helps farmers diversify their income (through the sale of animals and value added products), expand their resource base through increased sources and varieties of feed (common lands, boundary and fence lines, roadsides and browse from trees and shrubs) and diversify their diet with meat and milk products. Headey and Ecker (2013) in their recent research on measuring food security, write that diversity of diet is one of the better indicators of food security. Goats can significantly improve such diversity for people whose diet is comprised mainly of one or two staples.

It is important to understand the interaction between “negative events”, shocks, the potential reduction in food security and the potential for goats in agroforestry systems to protect against such shocks. Negative events like drought often lead to crop failure, dry pastures and dry wells and streams. These shocks in turn can result in: a) reduced stover, b) reduced food production, c) reduced income, d) reduced forage, and e) reduced water supply. These five factors reduce food security. Goats can help reduce a farmer’s vulnerability in each of these five areas. Since goats prefer browse, they are less dependent on crop stover. Because browse is less impacted by drought, food production from goats will be less vulnerable to drought. Again, the goat’s preference for browse makes it less dependent on forage species like grasses and forbs. Some species of goats are capable of growth while only drinking once a day, and the black Bedouin goats of the Sinai desert can drink only once every four days (Silanikove 1997).

When trees are added into the system, the subsistence farmer obtains even greater protection from these five shocks of drought. The deeper root systems of trees over annual crops allow for greater drought resistance and more reliable production of fodder, food and cash crops. Fresh tree leaves are more nutritious than dried stover which is often high in ligno-cellulosic content (Ben Salem and Smith 2008). Timber/fodder trees can be kept in reserve until a time of financial need. So through the integration of goats into an agroforestry system, the subsistence farmer achieves greater protection from each of these five shocks produced by the negative event of drought (Figure 1).

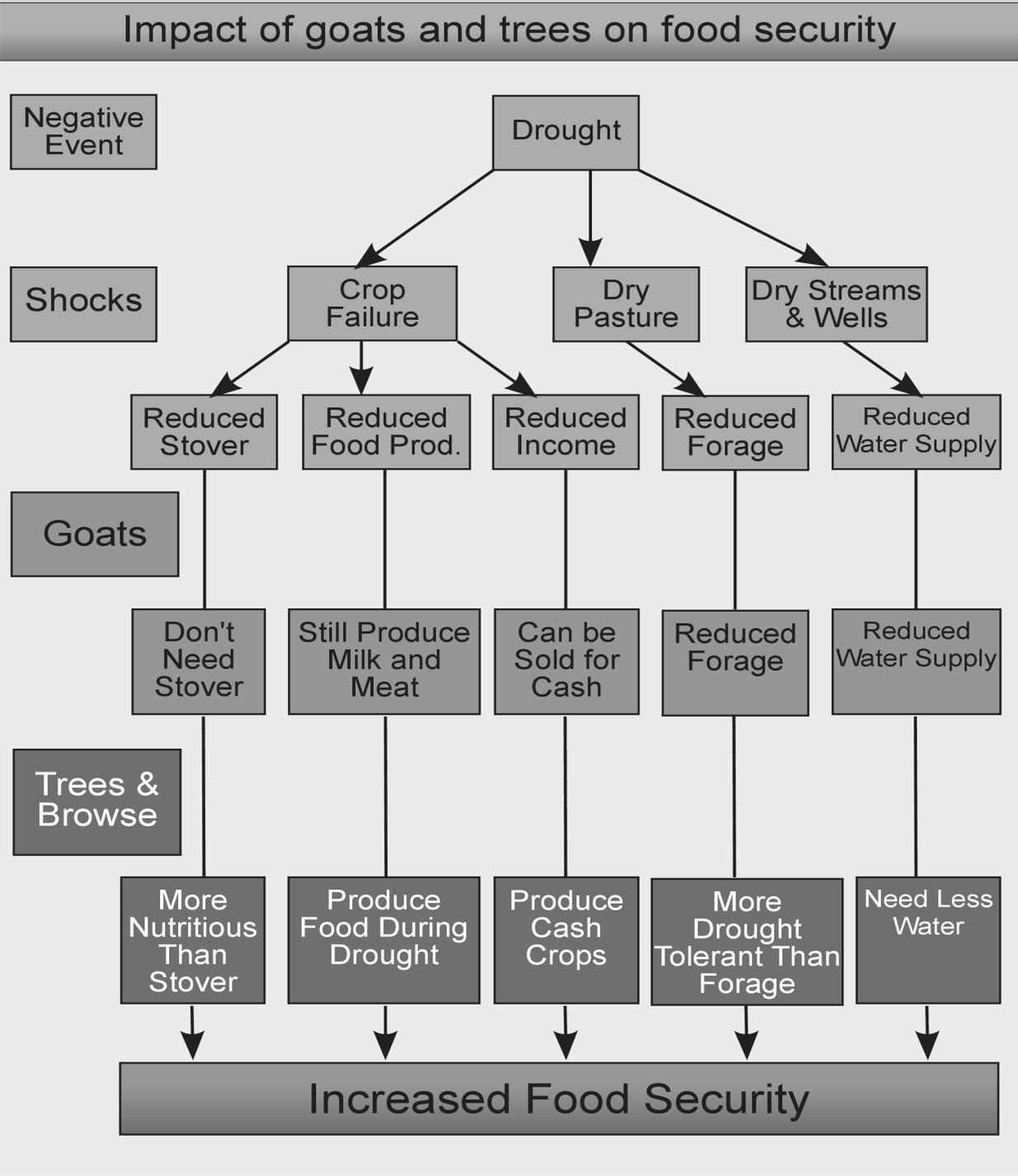


Figure 1 The impact of goats and trees on food security

As small ruminants, goats diversify risk more than larger livestock like cattle or camels, and they are more tolerant of high temperatures and low quality forage (Gwaze *et al.* 2009). Because goats are browsers, they prefer the leaves of trees and shrubs. The structure of a goat’s mouth and tongue enable it to select individual leaves and blades of grass in order to maximize the

nutritional value of its forage. In contrast, cattle will tend to grab large bunches of forage with their tongues and teeth (Heckman *et al.* 2007). Thus goats are better suited to consume fodder from trees and shrubs produced in agroforestry systems, compared to cattle or sheep which prefer grasses and forbs. Many trees used for timber and green manure are also well suited as browse for goats. The stability which trees and perennials lend to an agricultural system also enhances the stability of production from goats in such a system. Stability of income and food (the reduction of risk) is one of the highest priorities for the subsistence farmer. This helps explain the preference of poor farmers for goats over cattle. This is especially true for women, who are often among the poorest of farmers with access to the fewest resources (G Animut *et al.* 2000; Valdivia 2001).

## THE PLACE OF GOATS IN AGROFORESTRY SYSTEMS

Although there are many configurations for such agroforestry systems, contour hedgerows are a well-known example of an agroforestry system which can produce both food for humans and fodder for animals, while conserving soil fertility and reducing erosion (S. L. Arya *et al.* 2011). In one project where hedgerows were introduced for the production of green manure to sustain soil fertility, farmers refused to follow project guidelines and instead used the leaves as fodder for their goats, and then used the goat manure on their fields (Mugwe *et al.* 2009). Research is needed to compare the differences between goat manure and tree leaves for sustaining soil fertility and reducing erosion. The lack of such research points to a failure to appreciate the significance of animals in the agroforestry systems of subsistence farmers (Magcale-Macandog *et al.* 2010).

In most silvopastoral systems in developed countries, goats would not provide a significant advantage over cattle or sheep, since lower tree branches are pruned annually for the purpose of producing saw logs. But in the developing world, where labor is cheaper, branches are often cut on a daily basis to provide browse for livestock either *in situ*, or in a cut-and-carry system. In such a system, goats will better utilize the browse than cattle or sheep. Blending the three species would also increase production, as each has different and complementary feeding preferences for grass, forbs and browse.

In the home garden, goats provide a means by which prunings and crop residue are transformed into fertilizer. Given that many subsistence farmers are unable to afford commercial fertilizer, the production of fertilizer on their own farms is essential. The fact that the farmer will also get milk and meat from the process helps explain why the above farmers were so reluctant to use trimmings for green manure. It would simply be a less productive system that would not increase food security as much as using the trimmings for fodder (Tanner *et al.* 2001). Although the use of fodder banks is often cited in the literature, in practice the subsistence farmer prefers a system which utilizes multipurpose trees in integrated systems, rather than single purpose fodder trees. It is in the farmer's best interest to select trees which are planted for food production, but will serve as a source of fodder while growing, and a source of timber or fuel wood when cut, allowing for the continuous cycling of carbon from plant to goat to manure to field (Thomas *et al.* 2002).

## CONCLUSION

The integration of goats in agroforestry systems is a common practice for subsistence farmers in the developing world. This is partly due to the need to reduce their vulnerability to shocks from negative events which reduce food security. The farmer must protect against all shocks which are known to occur in the local region through techniques of asset and income diversification and risk spreading in space and time. The integration of goats into agroforestry systems helps farmers to diversify their assets and income, and to spread risk. This is accomplished primarily through the relatively stable production of tree fodder, and the preference of goats for browse. The use of goats in agroforestry systems to improve food security deserves more research by academic, government and scientific institutions than it has received in the past. Researchers who want their work to benefit subsistence farmers should investigate the true value of goats to increase the productivity of agroforestry systems through the cycling of carbon from trees to agricultural fields and home gardens.

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