MIXED CROP-LIVESTOCK PRODUCTION SYSTEMS OF SMALLHOLDER FARMERS IN SUB-HUMID AND SEMI-ARID AREAS OF ZAMBIA

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Abstract

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Livestock production activities among small-scale farmers of semi-arid (Agro-ecological zone 1) and sub-humid (Agro-ecological zone 2) areas of Zambia are integrated with crop production activities in what is termed as crop/livestock farming system. This is a closed system in which production of one enterprise depends on the other. In Zambia, crop production depends on draught animals for tillage of cropping area, animal manure for fertilisation of crops while livestock depend on crop residues for dry season feeding. Good quality grass is generally available in adequate amounts to support reasonable level of livestock productivity during the rainy season. But livestock rely on low quantity and poor quality, highly fibrous perennial grass from veld and fibrous crop residues during the dry season. These resources are inadequate to support optimum livestock productivity activities. Poor nutrition results in low rates of reproduction and production as well as increased susceptibility to diseases. With the increasing human population cropping land is expanding, leading to increased production of crop residues. This has however, reduced the grazing land available for ruminant production. In Zambia large quantities of crop residues (stovers, husks and straws, legume tops and hulls, sugar cane tops, cassava leaves, potato vines, etc.) are left in the field where they are wasted each year because small-scale farmers lack the knowledge on how best to use them. There is a need to find ways to reverse this situation by adapting known and workable technologies to local conditions and by introducing new approaches for improving the use of crop residues and poor quality fibrous feeds. Efforts should also be made to enlarge feed resource base. The technologies should be simple and effective. In the presence of a dynamic market system, livestock production in a crop/livestock system could be intensified and made profitable for small-scale farmers.

1. INTRODUCTION

A mixed crop-livestock farming system consists of integrated crop and livestock activities. Field crop production depends on the supply of draught animals and animal manure. Draught animals play a key role in tillage of land while animal manure fertilises field crops. Livestock in this system depend on extensive grazing of natural veld and crop residues during the dry season. This is a closed system in which waste products of crops are used by livestock, which in turn return its own waste (manure) back to the crop field.

2. DISTRIBUTION OF MIXED SYSTEMS

Mixed farming is the largest animal production system in the world (Table I). It produces 92% of world's milk supply, 70% of sheep and goat meat and 100% of buffalo meat. Half of this meat and milk comes from developing countries [1]. About 40–80% of livestock in the tropics are associated with mixed crop-livestock farming systems. In Zambia, over 97% of goats and more than 70% of cattle are reared on smallholder traditional mixed farming systems.

TABLE I. LIVESTOCK INVENTORY OF MIXED FARMING SYSTEMS*

Species	Number (millions)	Percent of global population	Percent in developing countries
Cattle	860.6	66.9	78.8
Buffalo	148.0	100.0	99.9
Sheep and goats	1096.8	63.9	87.8
Dairy cattle	192.2	85.0	78.7

*Data have been taken from [2]

3. CROP RESIDUES FOUND IN ZAMBIA

Crop residues found in Zambia include stovers of cereals such as sorghum, maize and millet and haulms of leguminous crops such as beans and groundnut, straws from rice and other crops, sugar cane tops, cassava leaves, sweat potato vines and planted agro-forestry species. Maize stover is the most abundant of all crop residues in Zambia.

Many of these crop residues are left in the field after harvest. Livestock are allowed to graze them in the field. The crop residues are trampled by livestock, and termites and forest fires quickly destroy them. Farmers do not have the know-how on how best to utilise these residues which could form a major source of livestock feed. Some programmes in Zambia (e.g. Southern Province Household Food Security Programme) have started to sensitise farmers to collect crop residues from the field and store them in homesteads. They are trained on how and when to give crop residues to animals and also how to treat crop residues to make them more palatable [3].

4. ADVANTAGES OF MIXED FARMING SYSTEMS

Mixed farming systems are found to be more efficient compared to specialised crop or livestock production systems [4]. Land is more intensively utilised as population density increases, and crop-livestock interactions intensify. An example is the predominantly cassava-livestock interaction in densely populated areas of Nigeria where 77–100% of animals are fed on farm-grown cassava, whereas in the sparsely populated areas of Zaire and The United Republic of Tanzania, only 8–50% of animals are fed on cassava [5]. Thus population increase has led to intensification of the system in Nigeria.

Mixed farming is beneficial in that it improves soil fertility. Adding manure to soil, increases nutrients and soil water holding capacity and improves soil structure [2]. In addition, if rotations of various crops and forage legumes are used, they replenish soil nutrients and reduce soil erosion.

The crop-livestock system has the advantages of allowing diversification of risks, using labour more efficiently, recycling wastes thus preventing nutrient losses, adding value to crops and crop products while providing cash for purchasing farm inputs. This system is responsive to market development. When there is access to dynamic urban markets, there is positive intensification and diversification of production. Farmers become integrated into the market economy, specialising and allowing them to take advantage of economies of scale. An example is the semi-arid Machakos District of Kenya where because a dynamic market was available, horticulture and smallholder dairy production activities became very profitable. The

extra income from these profitable ventures has been put back on the land for soil improvement programmes thus making the system sustainable.

5. FAILURE OF MIXED SYSTEMS

Crop-livestock systems can fail and more rapidly so in semi-arid areas which cannot support intensive cropping. When human population grows, more and more grazing land is converted to cropland thus reducing grazing land. This reduces nutrient flow into cropland. Crop production is pushed to marginal areas causing soil erosion; consequently, farm size becomes small and forage for livestock reduces. With deteriorating crop/grazing land ratio and without adequate substitution of soil fertility by other sources, fertility gaps arise. Losses of 15 kg N/ha per year in Mali and 100 kg N/ha per year in Ethiopian highlands have been reported [2]. Declining soil fertility, overgrazing, increased soil erosion and loss in soil microflora result in loss of agricultural productivity.

6. USES OF LIVESTOCK IN CROP-LIVESTOCK SYSTEMS

For rural people on mixed farming systems, livestock is the important link to the money economy and an essential element in their survival strategies [6]. A survey carried out in 1995, of 211 smallholder farms in medium-rainfall crop-livestock system in Zambia, identified draught power (33.3%) followed by the need for cash (30.5%) as major reasons for rearing cattle. For goats, the main reason was the need for cash (37.5%) followed by consumption (35%) (Table II). This cash was mainly used for buying seeds, fertiliser and chemicals (39.6%) and for purchasing food (25.2%). Seventeen and 14.4% of the cash was used for buying farm equipment and paying school fees, respectively. Manure was used for vegetable growing. Although manure use in this study was low, it is essential in the Zambezi flood plain of Western Province. In this area, crop production is only possible after application of manure to the cropping area by weekly corralling of the animals in the field. Thus smallholder farmers who do not own livestock are the most food-insecure.

7. CONSTRAINTS TO LIVESTOCK PRODUCTION IN MIXED FARMING SYSTEMS

7.1 Negative soil nutrient balance

The major constraint in most crop-livestock mixed systems on smallholder farms in developing countries, including Zambia, is the negative soil nutrient balance. Deficits are often covered by flow of nutrients from communal grazing areas to cropland but this is not adequate. Recycling of nutrients and control of soil erosion in these areas is a big challenge to researchers and development workers.

7.2. Scarcity and poor quality of feeds

Ruminant animals on smallholder farms of mixed system depend on fibrous crop residues and native pastures for the bulk of their feed requirements. These feeds are inadequate in quantity and are of poor quality with low digestibility especially in the dry season.

TABLE II. REASONS FOR REARING CATTLE AND GOATS

Parameter	Percent of total smallholder farms surveyed	
	Cattle[a]	Goats[b]
Income	30.5	37.5
Consumption	2.8	35.1
Draft power	33.3	0.2
Manure	5.5	8.5
Milk	12.9	2.0
Lobola	10.8	1.3
Social occasions	3.5	14.8
Social status	0.8	0.7

Total farms surveyed: a= 211; b= 459.

8. SOLUTIONS TO MIXED FARMING SYSTEMS

There is a need to generate environmental friendly technologies and policies for accelerated production. Many technologies having the potential to improve the condition of smallholder farmers are known, but the major challenge is for extension workers to convince farmers to adopt these technologies. Methods already known need to be applied at the farm level to test their adaptability and to demonstrate their profitability to farmers. Other methods of treating residues and evaluating supplements should continue to be researched. New dry season feed resources that can be integrated into the production system should be identified.

There are a number of technologies that can be introduced to smallholder farmers to improve quantity and quality of feeds and to increase animal productivity. These are:

- Improving soil by mulching, conservation tillage (which is being promoted by Zambia National Farmers Union, ZNFU), contour farming, terracing and strip cropping [7]
- Introducing multipurpose fodder shrubs, grasses and legumes to reduce soil erosion and as animal feed [8]
- Improving feed quality through treatments of crop residues [9]
- Reducing nutrient losses from manure by stall feeding
- Strategically supplementing specific classes of animals (e.g. lactating animals) to improve efficient use of limited feed
- Using multi-nutrient feed blocks.

Soil improvement studies with shrubs and legumes have been carried out in Zambia [8] and programmes emanating from such studies are now being implemented at the farm level (e.g. Sustainable Development Programme in Southern Province). However, these programmes have excluded the utilization of trees and shrubs for livestock feeding. Moreover, research efforts on treating crop residues by research institutions in Zambia have not been followed by adaptation of the technology at the farm level. Future research should address these aspects.

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