Crop–livestock systems in northern Ghana

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Abstract

The rotational fallow system used in traditional farming for sustaining crop productivity is giving way to permanent cultivation due to pressure on land. In the past, the subsidy on inorganic fertilizer gave room for its high adoption. The removal of this subsidy in the 1980s has been followed by a decline in the use of inorganic fertilizer. In most parts of northern Ghana, some use is made in one way or another of crop residues and manure, but without due attention to efficient management, utilization, and environmental impact. The current prevailing situation of high fertilizer cost, declining soil fertility, and insufficient feed for livestock makes it very important to identify sustainable crop and livestock integration systems to address these issues. This paper takes a critical look at crop–livestock systems in the savanna zone of northern Ghana. It gives an overview of the area, existing crop–livestock systems, constraints to the systems, and the management and pricing of crop residues and manure. Also provided is information about ongoing research and development in the systems and details of production figures for crops and livestock in Ghana.

Résumé

Le système de jachère de rotation qui sert à maintenir la productivité des cultures dans l'agriculture traditionnelle cède progressivement la place à la culture permanente en raison de la pression exercée sur la terre. Dans le passé, la subvention à l'engrais inorganique avait favorisé une large adoption. La suppression de cette facilité dans les années 1980 s'est soldée par une diminution de l'emploi de cet intrant. Un peu partout dans le nord du Ghana les résidus culturaux et le fumier sont utilisés d'une manière ou d'une autre sans accorder l'attention requise à leur gestion efficace, leur utilisation et leur effet sur l'environnement. Devant la situation actuelle caractérisée par le coût exorbitant des engrais, l'appauvrissement des sols et la pénurie fourragère, il est très important d'identifier des systèmes durables intégrant culture-élevage. Cette communication examine d'un oeil critique les systèmes associant l'agriculture à l'élevage dans la savane du nord du Ghana. Elle offre une vue d'ensemble de la région, des systèmes d'association culture-élevage en vigueur, des contraintes inhérent aux systèmes, de la gestion et de la fixation des prix des résidus culturaux et du fumier. Elle renseigne également sur les activités de recherche et développement en cours relativement aux systèmes, et fournit des chiffres de production détaillés aussi bien pour les cultures que pour le cheptel au Ghana.

Introduction

Ghana has a total land area of 23.9 million hectares of which 57.1% is agricultural land and 18.1% land under cultivation. (PPMED 1991). The country is located within latitude 4º44'S and 11º11'N and longitude 3º11'W and 1º11'E. There are ten administrative regions. The country has a population of 18 million (1998 estimates) with a growth rate of 3%. About 50% of the population work on the land. Ghana has significant mineral resources, including gold, bauxite, manganese, and diamonds. However, agriculture is the backbone of the economy. It contributes about 50% to GDP and 60% to export earnings. Crops and livestock alone (i.e., the agricultural sector excluding cocoa, forestry, and fishing) accounted for 33.2% of GDP in 1989. About 80% of the total population is directly or indirectly supported by agriculture and related activities. The bulk of production is by smallholders who constitute about 85% of the farming population (PPMED 1991). Table 1 gives the annual rainfall and growing periods of the agroecological zones in Ghana. The Guinea savanna lies south of the Sudan savanna and is the largest in land area. The two subzones account for nearly 64% of the total land area of the country.

Northern Ghana consisting of the Guinea and Sudan savannas is made up of three administrative regions (Northern, Upper East, and Upper West). In general, northern Ghana experiences two distinct seasons, wet and dry, almost of equal duration. Rainfall in the zone is erratic with long periods (more than 10 days) of dry spells. The rains begin in April/May and end in October. The rest of the period, November/December through to March, is characterized by very dry and hot weather. The vegetation consists of short, deciduous, widely spaced, fire-resistant trees, which do not form any close canopy and the general ground floral cover is solely grass of varying heights. More often, the soil surfaces are bare in the dry season after bush fire.

In northern Ghana, farming is the prime occupation of the population. Most farmers regard food crop cultivation as their major occupation for subsistence. Livestock is kept as a minor occupation for diverse purposes. With increasing population leading to increased pressure on land, there has been a higher level of interaction between crop and livestock activities. Farming in the zone is mainly rainfed. Crops mainly cultivated include maize, yam, cassava, rice, sorghum, millet, cowpea, groundnut, soybean, and tomatoes. The area

Table 1. Rainfall distribution by agroecological zone in Ghana.

Zone	Mean annual rainfall (mm)	Length of growing season (days) Major	Minor
Rain forest (humid)	2200	150–160	100
Deciduous (humid)	1500	150–160	90
Transitional (subhumid)	1300	200–220	60
Coastal savanna (subhumid)	800	100–110	50
Guinea savanna (subhumid)	1100	180–200	–
Sudan savanna (subhumid)	1000	150–160	–

Source: PPMED (1991).

is the leading producer of maize, rice, sorghum, millet, and groundnut. It also accounts for a significant proportion of Ghana's populations of large (cattle) and small ruminants (sheep and goats). A typical village transect will not miss these natural resources and their land-use categories. Soil infertility, especially on bush farms, is a general problem. In this light, the full integration of livestock into the farming system, aimed at sustainable, environmentally friendly productivity, is crucial for the development of the area.

Land is the most important farm resource. Though land is generally available, it exists at varying levels of soil fertility. In some areas, specifically the Upper East region, land is increasingly becoming scarce due to population pressure. Land ownership in the zone is mainly communal. Use rights are only leased to the farm household by the village earth priests (called *Tendaamba*, *Tendanaa*) free of charge. Therefore, the selling of land is not allowed. Land is usually given to the household or compound head, but all household members have access to it. Apart from land, the household head is in charge of all other resources and he retains the final decision on the use of these resources (Otchere et al. 1997a). Table 2 gives the average land area and percentage distribution of size of holdings by regions in northern Ghana. Most people in the zone have small land holdings except in the Upper East region where they are relatively larger, i.e., more than 1.2 ha, than in the country as a whole. However, this is changing due to increasing population.

The unfavorable and most unpredictable nature of the weather during the cropping season makes crop husbandry as a sole venture very risky. Farmers therefore do risk sharing by

Table 2. Land area and percentage distribution of size of holdings by region.

Region	Area (ha)	% distribution of size of holding (ha)		
		< 1.2	1.2–2	> 2
Northern	70.4	19	43	38
Upper East	8.8	48	32	20
Upper West	18.5	16	42	42
Mean for Ghana		60	25	15

Source: PPMED (1991).

engaging in a few more activities. Family labor is mainly used for agricultural activities. Livestock (ruminants) herding is done using child labor, except in a few isolated cases where hired herdsman (Fulani) labor is employed (Otchere et al. 1997b). Generally, there is always a conflict in adult labor use or competition between the crop and livestock subsectors, especially during the wet season. This probably explains why the animals are often left in the care of young children. Demographic imbalance, in which most of the old men, women, and children are left in the villages, is widespread due to urban drift by the youth. However, there is a division of labor between the genders. Women's labor contribution towards agricultural output and family or household upkeep is quite significant and duly recognized. Women are also actively involved in the marketing of farm produce.

Importance of crop–livestock systems

In recent times, as a result of increased population pressure, the prevalent farming system of rotational fallow with long fallows lasting 5–10 years or more has given way to shorter bush or grass fallows that last 2–3 years and continuous cropping systems which are more nutrient demanding. This has significantly affected crop production. The systems evolving are incapable of conserving soils against wind and water erosion and in restoring soil fertility, thus resulting in deterioration of the resource base of the soil. Consequently, there is the need to identify sustainable farming systems such as crop–livestock systems that allow continuous cultivation of the same piece of land.

Crop–livestock systems are mixed farming ventures in which there is a mutual interdependence between crops and livestock. The interdependence of crops and livestock in the existing farming systems can be viewed within the context of the biological cycles of matter and energy transformation. The soil-plant-animal-human relationship is of interest and worth noting. Soil nutrients taken in by plants (crops) for their growth are made available to animals when ingested. These nutrients are used up in various biological processes in the animal and some are later voided with various products (milk, meat) and by-products (feces, urine). More often, nutrients voided as by-products frequently account for soil nutrient balances and thereby enhance crop production. The common observation is that nutrients in the plant or animal products used by humans as food are usually shipped away to urban areas and never returned to their place of origin for nutrient balance purposes. The complete neglect of these two sources of nutrient recycling in the observed bio-geo-chemical drift seems to underline the observed widespread low soil fertility and degradation of both grazing and cropping lands.

Various resource flow diagrams in the zone often show more arrows to the habitat or the urban centers. A typical example is the natural resource flow in a village (Tuna area) in northern Ghana. As a result, the urban centers are getting choked with organic nutrients while the cropped and/or the grazing fields are being depleted of nutrients. Crops cultivated on compound farms (*sieman*) are found to perform better than in the nearby bush fields. Farmers in such communities have a clear understanding of why crops in the *sieman* perform better. They often explain that the droppings from free roaming animals around the homestead, the household refuse generated, and the feces from humans all account in the nutrient build-up in such soils for fertility maintenance.

There are number of important reasons why farmers adopt crop–livestock systems. These include:

- *use of livestock manure in sustaining soil productivity for continuous land use*
- *livestock, particularly small ruminants, stand out as an important source of cash at the beginning of the growing season for the purchase of crop inputs*
- *the system allows excess crop production to be converted to animals*

- *livestock use as food security in times of crop failure and a form of savings for emergency and important occasions*
- *animals may also be used as a source of farm power (animal traction)*
- *livestock are used to bridge the "hunger gap" usually experienced at the beginning of the raining season.*
- *general stabilization of the farming system*

Statistics on crops and livestock

The major food crops cultivated in Ghana are cassava, maize, sorghum, rice, millet, yam, plantain, cocoyam, and groundnut. These crops have seen little or no increase in production (Table 3). Where there has been an increase in production, it is not high enough to balance the high population growth rate. Northern Ghana is very important in the production of maize, sorghum, rice, millet, yam, groundnut, and cowpea. On average, the zone produces more than 20%, of the country's maize, 40% of the yam, and 50% of the rice. It is also the main producer of sorghum, millet, cowpea, and groundnut in the country (Tables 4a and 4b). According to the Policy Planning, Monitoring and Evaluation Department (PPMED) (1991) the northern region is the leading producer of maize, yam, rice, sorghum, millet, cowpea, and groundnut in the country. This is also supported by 1993 crop production estimates as presented in Table 3.

Table 5 presents the livestock population in the three northern regions as compared to that of the country as whole from 1992 to 1996. From the data, it is obvious that, apart from poultry there has not been any appreciable increase in livestock production in the country. The three regions put together produce on the average more than 25% of the country's poultry, 30% of the sheep, 35% of the goats, 40% of the pigs, and 70% of the cattle. The northern region is crucial in livestock production in the country as it is ranked number one in terms of cattle, sheep, goat, and pig production among the 10 regions for most years (1992–1996) (see Table 5). However, pig farming in the region is experiencing a decline. In the Upper West region, production of sheep, goats, pigs, and poultry is gradually increasing.

Table 3. Production of selected food crops ('000 tonnes), (1987–1989).

Year	1987	1988	1989
Crop			
Cassava	2726	3300	3320
Yam	1185	1200	1280
Plantain	1078	1200	1040
Cocoyam	1012	1115	1200
Maize	598	600	715
Sorghum	206	178	215
Groundnut	191	230	200
Millet	173	192	180
Rice	81	105	67

Source: PPMED (1991).

Table 4a. Estimates (ha) of cropped area for some major crops in Ghana, 1993.

Crop region	Maize	Rice	Millet	Sorghum	Cassava	Cocoyam	Yam	Plantain
Western	42 560	9560	–	–	52 070	24 480	8850	32 490
Central	67 420	52	–	–	51 500	12 400	3100	7500
Eastern	122 500	4000	–	–	143 000	50 600	21 200	53 000
Greater Accra	14 400	620	–	–	22 360	–	–	–
Volta	46 480	3850	–	7000	53 760	5530	10 500	3850
Ashanti	97 100	4400	–	–	104 120	57 000	14 200	48 000
Brong-Ahafo	76 410	11 450	–	–	78 060	23 250	56 240	18 850
Northern	127 270	25 210	70 100	118 320	26 970	–	70 400	–
Upper-West	36 200	1500	6300	73 500	–	–	16 200	–
Upper-East	6330	16 040	70 640	110 770	–	–	–	–
Total	636 670	77 150	203 740	309 590	531 840	173 260	206 690	164 290

Table 4b. Production estimates (tonnes) for some major crops in Ghana, 1993.

Crop region	Maize	Rice	Millet	Sorghum	Cassava	Cocoyam	Yam	Plantain
Western	48 110	11 480	–	–	468 330	137 810	49 150	226 600
Central	80 890	570	–	–	458 350	59 520	16 120	45 700
Eastern	220 500	5600	–	–	1 573 000	344 000	349 800	424 000
Greater Accra	10 090	3300	–	–	91 680	–	–	–
Volta	65 100	14 460	–	7000	802 270	34 180	189 850	26 200
Ashanti	163 450	9140	–	–	1 121 960	503 510	163 870	411 300
Brong-Ahafo	152 800	21 020	–	–	1 259 700	156 520	735 840	187 500
Northern	166 890	60 210	60 980	127 030	197 350	–	995 370	–
Upper-West	47 060	2250	63 000	102 900	–	–	220 320	–
Upper-East	6030	26 330	74 080	91 380	–	–	–	–
Total	960 920	157 360	198 060	328 310	5 972 640	1235 540	2 720 320	1 321 300

Source: PPMED (1993).

Existing crop–livestock practices

Farming in the region is mainly small scale. In most parts of the zone, grazing land is being lost to crop production due to the increasing need to feed large families through extensive land cultivation. This emphasizes the need to look critically at crop–livestock systems. Typical in the zone is the great number of comparatively small herd holdings which are incapable of generating enough manure to meet the recommended 5–10 t/ha application levels. Under the circumstances, manuring requirements may therefore be adequate for only small-size farms under intensive or sedentary agriculture. Apart from the compound farms, one other area that has seen the efficient use of such limited quantities of animal droppings is dry-season gardens. The free-range management system of animals contributes immensely to the low harvest of manure. Farmers without animals spend time collecting pig and cow dung for crop and vegetable farming.

Two main farm types are found in the zone. These are compound farms (immediately around the compounds and usually cropped every year) and bush farms (further from the

Table 5. Livestock population in northern Ghana (1992–1996).

		Livestock population				
Livestock	Region	1992	1993	1994	1995	1996
Cattle	Northern	448 765	460 051	454 633	357 557	429 460
	Upper East	189 816	202 957	216 885	210 830	214 717
	Upper West	243 193	213 773	224 700	226 947	284 162
	Country total	1 159 431	1 168 640	1 216 677	1 112 106	1 247 861
Sheep	Northern	382 054	432 469	342 422	267 090	339 406
	Upper East	159 000	151 680	202 761	173 983	211 670
	Upper West	255 854	190 207	200 000	296 679	331 819
	Country total	2 125 522	2 224 974	2 215 964	2 070 147	2 418 738
Goats	Northern	412 198	401 222	342 411	265 929	365 314
	Upper East	185 768	136 210	167 026	160 922	192 689
	Upper West	361 93	266 933	380 000	463 895	542 316
	Country total	2 157 278	2 124 529	2 204 150	2 155 938	2 532 710
Pigs	Northern	112 281	114 365	83 390	75 051	45 727
	Upper East	28 08	32 012	45 000	32 446	36 767
	Upper West	43 611	41 216	50 396	62 049	68 886
	Country total	413 243	408 134	351 169	3 654 498	354 678
Poultry	Northern	1 345 890	1 729 815	1 348 263	1 468 320	1 559 865
	Upper East	903 025	923 693	890 777	888 475	811 925
	Upper West	859 787	636 919	860 000	912 898	1 005 733
	Country total	11 231 574	12 169 523	12 289 376	13 247 312	14 589 303

Source: VSD (1992–1996).

houses and cropped on a bush fallow system). All villages have bush farms but some do not have compound farms. Where compound farms are not cropped, the area is reserved as grazing for small ruminants. Animals are tethered, and for goats in some places “cut and carry” feeding is practiced.

In areas where animal manure is used, it is applied to compound farms. Two basic methods are used. The first is keeping the animals in kraals and feeding them or animals are herding by hired herdsman (Fulani) or children, and returning the manure collected overnight to the compound farms. The second is the dynamic kraaling method. This method involves tethering the animals (cattle) every evening near the homestead, initially closer to the

compound house in the dry season but by the time the compound farms are cultivated, they are seen tethered away from the house at the edge of the compound farm. Maize is the main food crop put on the compound farms. Tobacco, a cash crop, is usually cropped after harvesting maize.

Crop residue management and pricing in crop–livestock systems

The use of crop residues and agroindustrial by-products to feed animals is identified as the crop contribution to the integrated system. These residues which would have otherwise been of no nutritional value to humans are transformed by the ruminant animals with the help of microorganisms inhabiting the rumen into highly nutritious food substances (milk and meat) for human consumption.

As already indicated earlier, feces and urine voided by the animals in an integrated system are not wasted but are mixed (recycled) with the soil for crop production. Most times, this necessary element of linkage is broken by the direct recycling of such residues into the soil as mulch. However, the end result is not superior to the use of manure. The decomposition of the residues is very slow, especially with cereals where the C:N ratio is known to be high (usually > 30). Their nutrient release pattern may not coincide with the growth of the crop, which is not the case when manure is applied (Powell and Ikpe 1992). Furthermore, the undecomposed residue is collected and burnt before land preparation. Land preparation is mainly by simple hand tools and in some cases bullocks or tractors are used.

In the given agroecology, well over 5.2 million tonnes of dry matter (DM) of crop residues are estimated to be generated annually in the zone. At the macroplanning level, this quantity can feed the herds of ruminant stock in the zone for the period. The same cannot be said at household (micro) level where the average land area cultivated is about 2 ha. The residues generated at that level could account for only 20–30% rate of supplemental feeding for most parts of the dry season. Also some competition exists in the use of most cereal residues. Apart from livestock feed, the stalks are also used as fuelwood and fencing materials. Rice straw, for instance, is also used by women for firing kilns which are used in making pottery. The same material is also commonly used in the making of mattresses popularly called *sori ko ejuma* (literally translated as wake up and go to work).

The bulky nature of most residues makes their transportation cumbersome, and so it may take a longer time of extension education before livestock farmers turn around and win this competition in the judicious use of these crop residues. For the same reason, they are usually left on the field to the mercy of the weather and livestock driven through. In most cases, bush fires sweep through and destroy them.

In most densely populated parts of the zone (especially Upper East region 150–160 persons/km^2), crop residues are sold or traded for other goods. Most important among the residues are those of legumes (especially groundnut) and cereal stalks. In most parts of the zone, collecting residues off your neighbor's field without authorization is forbidden. Table 6 gives a list of some residues and their prices.

Manure management and pricing in crop–livestock systems

The common sources of manure in the zone are cattle, sheep and goats, fowls, and pigs. Cow dung is the most important among them, mainly because there is more of it available. Competitive utilization of animal droppings especially cow dung has greatly affected availability for crop production. Cow dung is used as building material for plastering walls of dwelling places, material for treating woven straw baskets for storage, material for trapping termites to feed poultry, and as a repellant for application on crops to avoid damage by stray animals. The demand for its use as household fuel energy is increasing since firewood is difficult to come by.

Table 6. Types of crop residues and agroindustrial by-products marketed in parts of northern Ghana.

	Price ¢/100 kg	
Material	1994	1997
Rice straw (baled)	1000.00	–
Corn chaff (*dufu*)	–	19 200.00
Cassava peels	2000.00	5000.00
Cotton seed (whole)	9000.00	25 000.00
Groundnut	–	20 000.00
Sorghum/millet stocks (fuel)	–	5000.00
Pito mash	–	25 000.00
Pigeonpea waste	1900.00	2500.00

Exchange rate (November 1998): 1US$ = ¢2350.00.

The use of manure in crop production is gaining ground due to the realization by farmers of the need to fertilize their land to sustain crop productivity, and secondly, as a response to the high cost of inorganic fertilizer. The use of manure in crop production is widely practiced in most communities that rear cattle. Ongoing work by Abunyewa (1997) has shown that manure applied at the rate of 6 t/ha can give an average maize yield of 2.4 t/ha as compared to 1.1 t/ha on fields where manure was not applied, thus confirming earlier results using compost from sheep and goats (ARI 1993). Compound farms where manure is usually applied are mainly used for maize, millet, sorghum, tobacco, and vegetables such as okra and pepper. Composting using poultry and small ruminant waste and other household waste is currently being widely adopted by farmers as it is strongly recommended by extension officers from Ministry of Food and Agriculture (MoFA) and some NGOs.

The head of the family has the right to the use of manure. In the past, the Fulani herdsman used to have the sole right to the cow dung but presently most cattle owners are demanding the dung back for use on their farms. Hence, the right to use manure has to be part of the contract agreement. This underscores the importance being gained by the crop–livestock system. Presently, manure (specifically cow dung) is rarely sold but may be exchanged for other goods. In cities such as Kumasi and Sunyani in southern Ghana, poultry manure is currently bagged and sold to farmers, thus indicating the high demand for manure for urban gardening and other horticultural activities.

Constraints to crop–livestock systems

The major constraints to crop livestock systems in the zone include:

- *conflicting animal and crop management systems—the problem of keeping the two apart during the growing season*
- *communal system of land ownership which does not promote efficient land management*
- *the free range system of livestock keeping which does not promote efficient manure collection and hence sufficient manure is not available for the system*
- *improper animal management that leads to poor livestock health*
- *theft*

- *insufficient feed for livestock in the dry season*
- *the common farming practices of mounding and ridging which makes manure application cumbersome*
- *labor-intensive nature of carrying (managing) manure to bush farms because of its weight*
- *annual bush fires that destroy crop residues and other forage which could be used to feed livestock in the dry season*
- *alternative uses of crop residues and manure, making them less available for crop livestock systems*
- *inadequate information on the indigenous knowledge on crop–livestock and economically proven viable systems in the zone.*

Ongoing research and development in crop–livestock systems

As a matter of policy, crop–livestock systems were promoted in Ghana as far back as the 1930s, where animals were introduced on government stations (Babile, Manga, and Tamale, all towns in northern Ghana) to address soil fertility issues. However, until 1996, not much work was done in the field of crop–livestock system research. With the inception of National Agricultural Research Project (NARP) and National Agriculture Extension Project (NAEP) in 1996, some work has been done or initiated in the fields of research and extension, respectively, by the two projects. Under NARP, work is being done on the rate of manure and manure–inorganic fertilizer combinations that may sustain crop production. Studies are also being made on integrating sheanut with cattle production, developing sustainable agroforestry technologies for the rearing of livestock, and other animal-based farming systems research. Work is also being done in the field of extension, in educating farmers on proper ways of composting. The northern Ghana LEISA (Low-External-Input and Sustainable Agriculture) Working Group (NGLWG) and ILEIA (Information Center for Low-External-Input and Sustainable Agriculture, Netherlands) are collaborating with farmers and NGOs in the zone on the use of compost.

The Savanna Agricultural Research Institute (SARI) and the Animal Research Institute (ARI) are jointly working on the use of pigeonpea as a short fallow crop. The pigeonpea is

pruned at the appropriate height and time so as to feed the biomass to livestock and return the manure to the field. Work is also ongoing on the use of pigeonpea biomass as a dry-season feed. In these studies, effort is made to obtain some appreciable amount of pigeonpea seed yield. As a result of the efforts of the two institutions and extension staff, pigeonpea, which was mainly used as a border crop by farmers in the zone, is now cultivated as a sole crop by some farmers. The two institutes are collaborating with the International Livestock Research Institute (ILRI) to study the reciprocal benefits of using crop residues as mulch or/and feed/manure and in situ grazing of livestock using maize intercropped with *Lablab*.

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