14. Crop-Livestock Linkages in Watershed Villages of Andhra Pradesh

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Abstract

The focus of this study is to characterize the watersheds in terms of crop and livestock development. Watershed development while improving the crop sector is expected to improve the feed and fodder situation and thus facilitate dairy development. This study analyzes the economic conditions of the people living in six watershed villages in Andhra Pradesh in the first year of implementation of the watershed program under the Andhra Pradesh Rural Livelihood Program (APRLP).

Keywords: Crops, livestock, watershed, livelihood, fodder.

Introduction

Livestock sector plays an important role in the rural economy of India with a high contribution to the gross domestic product (GDP) and a high absorption of female labor. The sector accounts for 5.59% to the GDP and 27.7% of the income from agriculture in India in 2001–02. In absolute terms, the sector has contributed 84.6 million tons of milk, 50.7 million tons of meat and 34 billion eggs and significant amount of organic manure.

The agriculture sector in India witnessed a skewed development since early 70's with much of the development-taking place in the irrigated regions at the cost of rain-fed areas. For example, the green revolution was confined to the irrigated and better-endowed regions of the country. To make up for this lacuna and also because the dry lands account for more than 60% of the cropped area in the country, several programs have been initiated for the development of dryland agriculture, like for instance, the introduction of the Integrated Wasteland Development Program (IWDP) of 1989–90 and the National Watershed Development Program for Rain-fed Areas (NWDPRA) of 1990–91. Improving agricultural production and restoring ecological balance are the twin objectives of these programs. Watershed approach allows for a more holistic development of the agricultural sector ie, crop and allied sectors like, horticulture, livestock, fisheries, etc., with focus on integrated farming systems and management of common property resources to augment family income and

improve nutritional levels of communities participating in watershed programs. The state of Andhra Pradesh in India has a very high coverage of watershed development program. Almost 30% of the total watersheds taken up in the country are located in this state and are taken up under various rural development programs. Another rural development program, Rural Infrastructure Development Fund (RIDF-VI) is implemented under the assistance of the National Bank for Agriculture and Rural Development (NABARD). The state government contributes only 10% of the cost of the project. This program covered 1345 watershed projects till the end of March 2004. Andhra Pradesh Hazard Mitigation and Emergence Cyclone Recovery Project (APHM & ECRP) was implemented during July 1997 and July 2002 in five districts viz., Adilabad, Chittoor, Anantapur, Nellore and Karimnagar. The project covered 20 watersheds in each district (Government of Andhra Pradesh, 2004). Thus, almost all the development programs are implemented on watershed basis.

To understand the impact of the watershed projects on the livelihoods of the people, a careful analysis of the base situation is essential. Such an analysis provides a baseline for concurrent evaluation to be carried out during the implementation of the project and impact evaluation to be taken up after the completion of the program.

This study analyzes the economic conditions of the people living in six watershed villages in Andhra Pradesh in the first year of implementation of the watershed program under the Andhra Pradesh Rural Livelihood Program (APRLP). The project is implemented under a consortium approach involving farmers, public sector organizations, private sector, NGOs and civil society organizations. There are few studies that closely examine the contribution of watershed programs on the livestock sector. This study with special focus on the livestock sector is to fill this gap in the literature.

Objectives of the Study

- Analyze the socio-economic features of the villages with watershed programs and characterize the farming and livestock production systems.
- Examine linkages between crop sector and livestock.
- Study the impact of watershed development on livestock sectors in terms of improving the livelihoods of the poor.

Methodology

The study uses the data collected from six villages in Andhra Pradesh where watershed program has been initiated under the APRLP. Particulars of sample villages and sample size of households in each village is shown in Table 1.

Table.1. Particulars of sample villages and sample size.

Village	Mandal	District	Households in the sample	Households in the village
Malleboinpally	Jadcherla	Mahabubnagar	60	230
Mentapally	Wanaparthy	Mahabubnagar	65	235
Thirumalapuram	Chintapally	Nalgonda	72	NA[1]
Kacharam	Yadagirigutta	Nalgonda	90	324
Nandavaram	Banaganapalli	Kurnool	63	1234
Devanakonda	Devanakonda	Kurnool	70	1798

1. NA = Data not available.

Data were collected for 2001–02, the year of initiation of the program. The characteristics of each village were recorded in terms of size distribution of landholdings, caste composition, availability of irrigation, rainfall, cropping pattern, size and composition of bovines, fodder availability, livestock feeding patterns, milk yield, income from different sources, income distribution and incidence of poverty.

The impact of watershed development on crop and livestock sectors is examined by analyzing the data pertaining to two villages in Medak district. One village is drawn where a watershed program has been on-going since last 5 years and the other is selected from outside the program area. This non-watershed village has the same agro-climatic features as the watershed village. A sample of 60 households is selected randomly from each of these villages.

A. Baseline Survey Findings: Six Watershed Villages

Agro-Economic Features: Six Watershed Villages

Social and Educational Characteristics

Of the six villages considered, Thirumalapuram has a very high proportion of scheduled castes (SCs) and scheduled tribes (STs) and Devanakonda has dominance of backward castes. The other four villages have a balanced distribution of castes. However, Nandavaram and Devanakonda have a low proportion of SCs and STs.

Malleboinpally, Mentapally and Thirumalapuram have low level of literacy among the heads of the households. However, a significant proportion of heads of households in Malleboinpally has secondary and above levels of education. Among the six villages, Nandavaram and Devanakonda have higher levels of education than the other four villages. These villages also have a low proportion of SCs and STs.

Rainfall and Irrigation

Four of the six villages (Malleboinpally, Mentapally, Nandavaram and Devanakonda) received about 600 mm per annum. One village (Thirumalapuram) receives as low as 571 mm per annum and one village (Kacharam) receives a high rainfall of more than 800 mm per annum. However, both these villages and Devanakonda suffered severe drought during 2002–03 with a shortfall of more than 40% in rainfall. Though the villages differ in terms of rainfall received per annum, all of them receive less than the state average rainfall of 940 mm in Andhra Pradesh.

All the six villages have very low irrigation ratio of less than 25%. However, two villages viz, Nandavaram and Devanakonda, have the lowest irrigation ratio of 3.9% and 14.7%. In the remaining four villages irrigated area forms about 20% of the net area sown. However, in the year of survey most of the wells were dried up. For more details on the above aspects, see Shiferaw et al. 2003)

Land Distribution and Cropping Pattern

Thirumalapuram has the highest proportion (more than 30%) of landless households followed by Malleboinpally, Kacharam and Devanakonda (10–14%). Menatapally and Nandavaram have an exceptionally low proportion of landless households (about 5%). Nanadavaram has very high land resource with 80% of the households belonging to the category of medium and large farmers. Devanakonda and Mentapally also have a high proportion of medium and large farmers. Malleboinpally has a high proportion of marginal and small farmers.

Pulses are the dominant crops accounting for 30 to 40% of the area in all the villages except Devanakonda. Paddy is insignificant in all the villages except Thirumalapuram and Malleboinpally where it has a share of more than 12%. Devanakonda has a high proportion of area (65%) under oilseeds and horticultural crops. In Nandavaram, horticultural crops and cotton are dominant. Oilseeds are important in Mentapally and Thirumalapuram.

Per Capita Income and Incidence of Poverty

Nandavaram has highest per capita income and the lowest incidence of poverty. The high proportion of large farmers and favorable monsoon are responsible for this high position. Thirumalapuram occupies second position in per capita income, but incidence of poverty is relatively high. The high proportion of the landless in this village appears to be responsible for high poverty. Kacharam has moderate level of per capita income, but incidence of poverty is relatively lower as compared to its

per capita income. Dairying is highly developed in the village and it is responsible for low incidence of poverty with a moderate size of landholding. Livestock sector contributes 30% of the household income. Malleboinpally and Devanakonda have per capita income of Rs 7850 and Rs 7510, respectively, but the latter has significantly lower incidence of poverty than the former. This is because of the high proportion of medium and large farmers in Devanakonda. Malleboinpally has very low proportion of households belonging to the category of medium and large farmers. Mentapally occupied the lowest position among the six villages in per capita income and incidence of poverty. This is neither due to drought nor due to landlessness. Livestock sector is highly backward, contributing only 7% to household income.

Livestock Production Systems: Six Watershed Villages

Introduction

The six watershed villages under study have been found to be distinct in terms of agro-economic characteristics. These differences are likely to have an impact on the livestock sector. Livestock systems can be broadly divided into small ruminant and bovine systems. Bovine systems differ in the types of bovines maintained. Given the data available, it is possible to classify the bovine systems into milk, work and mixed systems. If a household maintains only milch animals and meets the draft power requirements with hired animal power or tractor power, the system is designated as milk system. If a household maintains only draft animals, the system is designated as work system. If both milch animals and work animals are maintained, the system is designated as mixed system. There is another system in which only calf or dry animal is maintained. However, it is not considered here separately as there are very few households in this category. This section examines the livestock production systems existing in the six villages.

Size and Composition of Livestock

Participation in Livestock Sector

Participation in livestock sector at household level is measured in terms of the proportion of households maintaining bovines and small ruminants. A wide variation is observed in the proportion of households owning bovines not only between districts but also between villages in each district. Participation is high in Nandavaram and Thirumalapuram with more than two-thirds of the households maintaining bovines and low in Malleboinpally and Devanakonda with only 50% of

the households maintaining bovines. Kacharam and Mentapally have a moderate level of bovine activity with about 60% of the households maintaining bovines (Table 2).

Table. 2. Percentage of households maintaining bovines in sample villages.

Village	Bovine households	Non-bovine households
Malleboinpally	51.7	48.3
Mentapally	58.5	41.5
Thirumalapuram	67.6	33.8
Kacharam	62.9	38.2
Nandavaram	71.4	28.6
Devanakonda	47.1	52.9

Participation of the households in small ruminant production is substantially lower than their participation in the bovine sector. However, the activity is significant in three of the six villages viz, Thirumalapuram, Malleboinpally and Kacharam with 13 to 19% of the households maintaining small ruminants (Table 3). Further, maintenance rate is positively associated with size of landholding, indicating that the activity is biased towards resource-rich farmers.

Table 3. Percentage of households maintaining small ruminants.

Village	Marginal and small farmers	Medium and large farmers	All households
Malleboinpally	15.0	20.0	16.7
Mentapally	3.5	5.7	4.6
Thirumalapuram	22.2	21.9	19.4
Kacharam	13.6	14.3	13.3
Nandavaram	-	7.7	7.9
Devanakonda	3.7	5.6	4.3

Production Systems

Kacharam specializes in milk production. There is no work system in the village. All bovine holdings produce milk either in milk system or in mixed system. Thirumalapuram, Malleboinpally and Nandavaram have predominance of milk production with equal importance for milk and mixed systems. Devanakonda and Mentapally are backward in milk production with a high proportion of work animal holdings. The latter has very few holdings in milk system and milk production is taking place mostly in mixed system (Table 4).

Table 4. Percentage of households by production system.

Village	Milk	Mixed	Total milk	Work
Malleboinpally	54.8	32.3	87.1	12.9
Mentapally	10.5	44.7	55.2	44.7
Thirumalapuram	43.8	43.8	87.6	12.5
Kacharam	42.9	57.1	100.0	-
Nandavaram	17.8	57.8	75.6	24.4
Devanakonda	45.5	22.3	67.8	27.3

The size of bovine holding varies across villages. These differences partly arise due to variations in production systems. The average size of bovine holding is high in villages with a large proportion of mixed system. On the other hand, the size bovine of holding is small in villages with a large proportion of work system. Kacharam, Thirumalapuram and Malleboinpally have a high herd size of more than 5.6 and the other three villages have a low herd size of less than four.

Buffalo is the dominant milch animal in all the villages. However, the ratio of cows to buffaloes varies widely across the villages. Malleboinpally and Nandavaram specialize in buffalo milk production with only 12 to 14 cows per 100 buffaloes. On the other hand, Thirumalapuram has a significant proportion of cows (74 per 100 buffaloes) among milch animals. The remaining three villages, viz. Mentapally, Kacharam and Devanakonda have about 45 cows per 100 buffaloes (Table 5).

Table 5. Milch animals per holding and cow buffalo ratio.

Village	Milk		Mixed		All	
	Cows/100 buffaloes	Milch animals/ household	Cows/100 buffaloes	Milch animals/ household	Cows/100 buffaloes	Milch animals/ household
Malleboinpally	16	3.82	11	4.90	14	4.22
Mentapally	-	1.25	59	2.05	48	1.90
Thirumalapuram	161	1.85	47	3.29	74	2.57
Kacharam	15	2.17	68	3.57	47	2.97
Nandavaram	36	1.88	23	2.34	12	2.23
Devanakonda	29	2.07	60	1.78	38	1.97

Milk Production

Milk yield per animal is very high in Kacharam and Devanakonda and low in Thirumalapuram and Mentapally. Both the villages have crossbred cows. Buffalo

is predominant in Malleboinpally and Nandavaram, which occupy the middle position in milk yield. Poor performance of Mentapally and Thirumalapuram is due to the predominance of local cows with very low milk yield. When milk production per household is considered, Kacharam again stands at the top and Malleboinpally occupies second position pushing Devanakonda to the third position.

The distribution of milch animals by milk yield indicates the development of the dairy sector. Only Kacharam has a large proportion (65%) of cows with yield more than 3 liters. In all the other villages average yield of most of the cows is less than 2 liters per day. Devanakonda shows its superiority in milk yield of buffalo milk with nearly one-half of the buffaloes producing more than 3 liters per day. Malleboinpally and Kacharam also have a significant proportion of buffaloes (more than 20%) with high milk yield. A majority of buffaloes in Malleboinpally, Thirumalapuram and Nandavaram produce 1–2 liters per day and a majority in Mentapally and Kacharam produce 2–3 liters per day.

Development of market is also an important contributory factor for the development of the dairy sector. Mentapally is highly backward in marketing with only 23.2% of the milk being disposed within the village. Malleboinpally is also backward in marketing despite its high performance in production. Thus, the two villages in Mahabubnagar district are backward in marketing. If the sector is highly developed, marketing facilities will be developed automatically. But in the villages with backward agriculture, intervention in the infrastructure and development of market should go hand in hand with the development of production for the development of the sector.

Draft Animals

In backward agriculture, bovines are maintained mainly for draft animal power and milk production is secondary. As fodder availability improve, milk production becomes equally important and farmers manage the draft animal needs with hire services. Studies have shown that the proportion of small farmers maintaining work animals is low (Subrahmanyam and Nageswara Rao 1995). In some areas bovines are maintained for manure production. This is possible when grazing land is available in plenty. Development of dairy sector is dependant on mechanization of agriculture. A low proportion of farmers maintaining work animals and a low density of work animals is an indication of mechanization of agriculture**.**

Density of draft animals is the highest in Mentapally (1.14 ha^{-1}) and the lowest in Nandavaram and Devanakonda (0.49 ha^{-1}). The other three villages occupy a middle position (0.74 ha^{-1}). Except in Thirumalapuram the density of draft animals is lower on small farms than on large farms. Though the need for animal draft is reduced

through mechanization, there is no guarantee that dairy development takes place. Other conditions like availability of feed and fodder and demand for milk should also exist for the growth of dairy sector.

Feed Availability and Utilization

Information on feeding in the baseline survey is rough and collected at one point of time for the entire herd. However, data on crop residues is available that provides an indication about feed and fodder situations.

The quantity of feed per animal is calculated by converting all the animals into adult units treating young stock as 0.5 adult. All feeds are converted into dry matter by taking 0.25 of green fodder and 0.9 of dry fodder (crop residues) as well as concentrates. Information available reflects only stall-feeding, as the data on feed obtained through grazing is not available. The feeding levels are high in Kacharam and Nandavaram where the average quantity of dry fodder fed per adult animal is more than 2.5 kg day^{-1}. (Table 6). In Malleboinpally, Mentapally and Thirumalapuram the quantity of dry fodder as well as concentrates fed is low. The feeding of green fodder is high in Devanakonda and Kacharam, and close to zero in Mentapally and Nandavaram.

Table 6. Quantity (kg day^{-1}) of feeds fed per adult unit.

Village	Dry fodder	Green fodder	Concentrates	Dry matter
Malleboinpally	1.14	0.51	0.18	1.32
Mentapally	2.09	0.04	0.13	2.01
Thirumalapuram	1.76	0.34	0.02	1.69
Kacharam	2.52	0.96	0.35	2.83
Nandavaram	3.96	0.01	0.36	3.89
Devanakonda	2.00	1.48	0.42	2.54

For total feed on dry matter equivalent, Nandavaram, Kacharam, and Devanakonda top the list followed by Mentapally.

The distribution of bovine holdings according to the quantity fed per adult animal indicates the proportion of households facing feed scarcity. In the three villages with low feeding levels per animal as indicated in Table 7 only 10% of the households are able to feed their bovines with more than 4 kg day^{-1}and 50 to 74% of the households feed less than 2 kg day^{-1}. In the other three villages with higher feeding levels per animal 25 to 38% of the households feed more than 4 kg day^{-1}. However, there is a significant proportion of households (18 to 35%) with feeding levels less than 2 kg day^{-1} (Table 7).

Table 7. Percentage distribution of holdings by dry matter fed per day.

Village	<2 kg	2-4 kg	≥4 kg	Total
Malleboinpally	74.2	16.1	9.7	100.00
Mentapally	48.7	41.0	10.3	100.00
Thirumalapuram	59.2	30.6	10.2	100.00
Kacharam	31.6	43.9	24.6	100.00
Nandavaram	17.8	44.4	37.8	100.00
Devanakonda	35.2	32.4	32.4	100.00

Impact of Watershed Program on Livestock Sector

Introduction

The watershed program focuses on soil and water conservation and is expected to improve crop yields and green fodder availability. This, in turn, is likely to have an impact on milk production. To understand the impact of the program, we adopted with and without approach and analyzed the data relating to a village that has been covered under watershed program since 1999 and a nearby village with the same agro-climatic conditions and not covered under the watershed program. The sample for each of the two categories consists of 60 households. The questionnaire canvassed for the baseline survey of the watershed villages is also used for these two areas. The socio-economic features of the two villages are compared considering caste, education and work participation rate. Then the performance of agriculture is examined to understand the impact of the watershed program on agriculture. Finally, the impact of the program on the performance of the livestock sector is considered. For this paper only the findings related to the impacts of the watershed on the livestock sector are discussed below.

Size and Composition of Livestock

The watershed village differs significantly from the control village in the size, composition and productivity of livestock. Firstly, bovine activity is higher in the watershed village indicating that improvement in soil and moisture conditions leads to development of the livestock sector. This is because of the improvement in the availability of green fodder after implementing the soil and moisture conservation measures undertaken as a part of the program. The proportion of households maintaining bovines increased from 60% in the control village to 68.3% in the watershed village (Table 8). Secondly, there is a shift from small ruminants to bovine activity. Studies show that small ruminant activity is confined to resource-poor

areas (Hanumantha Rao, 1994). The shift from small ruminant to bovine activity in the watershed village indicates improvement in the resource base of the village due to the watershed program. The proportion of households maintaining small ruminants declined from 30.9% to 26.3% and this shift came because of the shift of small farmers from small ruminants to bovine sector. It is to be noted that though small ruminant production is more in resource-poor areas, it is not high among resource-poor farmers. The proportion of milch holdings increased from 22.2% to 39.0% and the proportion of work holdings declined from 47.2% to 22.0%. The share of mixed holdings also increased from 30.6% to 39.0%. As a result of these shifts, the proportion of bovine holdings producing milk increased steeply from 52.8% to 78.0%. Fourthly, the improvement in the bovine sector comes through productivity improvement and not through increase in the size of the herd.

Table 8. Livestock characteristics of the two villages.

Item	Watershed village	Control village
Percentage of households maintaining bovines		
Bovine	68.3	60.0
Non-bovine	31.7	40.0
Percentage of holdings maintaining small ruminants		
Small and marginal (<2 ha)	16.7	24.3
Medium and large (>2 ha)	37.0	38.9
All	26.3	30.9
Percentage of households by production system		
Pure milch	39.0	22.2
Pure work	22.0	47.2
Mixed	39.0	30.6
Total	100.00	100.0
Average number of bovines per holding		
Pure milch	2.1	2.3
Pure work	1.7	1.9
Mixed	4.3	4.1
Overall	2.0	1.6

Milk Production

The improvement in the green fodder availability in the watershed village improved milk production and this improvement came through spread of the activity and improvement in milk yield. There is no increase in the number of milch animals per

household. In fact, the number of milch animals per household declined from 1.44 to 1.37. But the value of milk output per household increased by 14.7% from Rs 7630 to Rs 8750 and the proportion of households producing milk increased from 52.8 to 78.0% (Table 9). This increase in production per household, despite decline in the number of animals per household, is contributed by the improvement in yield per animal by 24.7% from 550 liters to 686 liters. Further, the entire improvement in the yield took place in the milk system. The mixed system has not gained in milk production because its priority is for animal power for agricultural operations and milk production is secondary.

Table 9. Quantity and value of annual milk production.

Production system	Number of animals		Milk yield (L)		Output values (Rs)	
	Watershed village	Control village	Watershed village	Control village	Watershed village	Control village
Milch	1.58	1.75	809	513	10982	7950
Mixed	1.20	1.22	556	596	6670	7280
All	1.37	1.44	686	550	8750	7630

Fodder Availability and Feeding Levels

Crop residues, an important component in the livestock feed, are available from food grain crops and groundnut. The yield of crop residues is expected to increase with increase in the crop yield and shift in cropping pattern. Cropping pattern is more favorable to livestock feed in the watershed village as compared to the control village. The share of food grains is higher in the watershed village than in the control village and this is due to a larger extent of area under maize. The availability of crop residues per ha of cultivated land as well as per adult bovine unit in the watershed village is twice that of the control village both due to shift in cropping pattern towards food grains and higher crop yields

Because of the higher levels of fodder availability in the watershed village as compared to the control village, feeding levels are also found to be high. While the proportion of farmers feeding concentrates and green fodder is almost the same in both the villages, the quantities fed per animal differ significantly. About 14.6% holdings in the watershed village and 11.1% holdings in the control village feed green fodder. About 19% holdings feed concentrates in both the villages.

In the watershed village there is a steep increase in the quantity of greens fed and decline in the quantity of concentrates. With significant improvement in the availability of green fodder in the watershed village, farmers substitute concentrates

for green fodder. The level of feeding dry matter is higher by 75% in the watershed village than in the control village (Figure. 1). The improvement in the feeding of dry fodder is only 35%. Thus, feeding levels improved through mostly green fodder and a little bit of dry fodder. These two types of feeds more than compensated the decline in the feeding of concentrates. It should be noted that farmers always try to manage with home-grown feeds rather than purchased feeds. The watershed program is expected to reduce the demand for concentrates because of the higher availability of green fodder. As the quality of animals improves, demand for concentrates will again increase.

Conclusion

There is a close linkage between the crop and livestock sector in the selected watershed villages. Livestock sector makes a significant contribution to the income in villages with well developed dairy sector. The success of the dairy sector depends on several aspects but feed availability is one of the critical factors influencing dairy development.

Impact study for a completed watershed village indicates that due to implementation of watershed program the availability of feeds and fodder increases and in this case particularly green fodder that stimulated the growth of dairy sector. At the same time the feeding of concentrates has declined indicating farmers' preference for home grown feeds/fodder. Clearly the watershed program is beneficial to poor and small-scale livestock keepers.

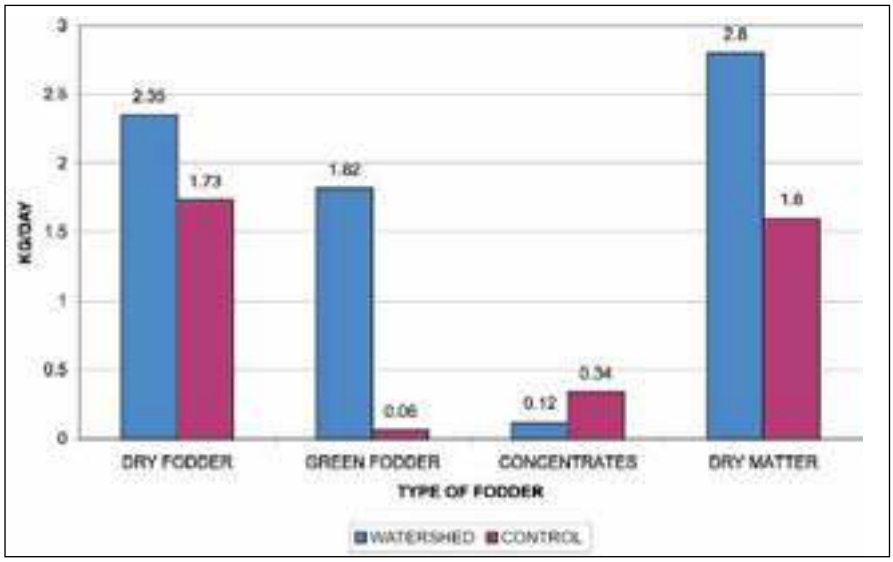

Figure 1. Quantity fed per adult unit.

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