প্রতিধ্বনি the Echo
An Online Journal of Humanities & Social Science
Published by: Dept. of Bengali
Karimganj College, Karimganj, Assam, India.
Website: www.thecho.in

Trend and Performance of Major Food grain Production

(A Study of Central Brahmaputra Valley Zone of Assam during 1971-2010)

Soma Dhar
Research Scholar, Department of Economics, Assam University, Silchar-788011
Email: dharsuma@gmail.com

Abstract

In the 21st century also, agriculture continues to be a fundamental instrument for sustainable development and poverty reduction in developing countries. Population of the developing world overwhelmingly concentrated in rural areas. Assam is one of the states of North Eastern India with a total geographical area of 78438 square km. About 86 percent of its total population lives in the rural areas (2011 census) with 70 percent directly or indirectly dependent on agriculture and 55 per cent of the workforce actually engaged in agricultural activities. Yet Assam's agriculture has made very little headway towards modernisation. Agriculture in Assam is still characterised by small holdings, low crop intensity, low productivity, low level of technology, meagre irrigation facilities. Central Brahmaputra Valley zone is situated in the centre of the state Assam occupying 7.04 percent of its total geographical area. Food grain is the predominant crop of the zone accounting for more than three fourths of the gross cropped area since the early 1970's. The decade-wise annual average growth rate of area, production and yield of major foodgrain crops in Central Brahmaputra Valley and Assam has been calculated for five periods, 1971-80, 1981-90, 1991-2000, 2001-10 and 1971-2010. The growth rate of production of total foodgrains during all the sub periods till 2000 was higher for Central Brahmaputra Valley than the state as a whole and the difference became more prominent during 1991-2000. It was only during 2001-10, Assam attained higher growth rate of production of total food grains.

Keywords: Annual Growth rate, Performance of agriculture and productivity of food grain.

1. INTRODUCTION:

Agricultural development is an indispensable prerequisite for the general economic development of a country. This is more so in case of developing or less developed countries. In the 21st century also, agriculture continues to be a fundamental instrument for sustainable development and poverty reduction in developing countries. Moreover population of the developing world overwhelmingly concentrated in rural areas. Three out of

every four poor people in developing countries live in rural areas (Yila and Thapa, 2008). Assam is one of the states of North Eastern India with a total geographical area of 78438 square km. About 86 percent of its total population live in the rural areas (2011 census) with 70 percent directly or indirectly dependent on agriculture and 55 per cent of the workforce actually engaged in agricultural activities. Even though the state is richly endowed in natural resources, such as abundant rainfall, alluvial soil, rich and diverse plant and animal genetic base, development of agriculture in Assam has not been satisfactory over the decades. In Assam, area allocation among various crops has shown a measure of structural rigidity that reflects the traditional character of Indian agriculture wherein foodgrains have remained the predominant crop accounting for more than three fourths of the gross cropped area since the early 1970's. Keeping in mind the importance of agriculture mainly of the foodgrain sector in rural based economy of Assam, the present study is made to find out the performance of major foodgrain crops in Central Brahmaputra Valley zone of Assam.

The purpose of the literature review is to summarize perspectives that might have a direct or indirect bearing on the conceptual design dealt with in this study. Here, we will consider some of standard literature which are related with the present study rather closely. Das (1984), quoted that Assam has been suffering from the lack of technological innovation. Whatever yield of crops it has achieved, is solely contributed by the natural fertility of the soil and hard labour of the peasants.

Agarwala and Hazarika (2004) found that out of six agroclimatic zones, only two zones namely "Central Brahmaputra valley" and "Lower Brahmaputra valley" can be classified as developed relatively or moderately. Roy and Bezbaruah (2002) stated that in comparison to all India standards, the Barak valley region as well as the state Assam continues to lag far behind.

2. OBJECTIVE:

The objective of the present study is to analyse the growth pattern of area, production and productivity of major foodgrain crops of Central Brahmaputra valley vis a vis Assam.

3. METHODOLOGY:

3.1 ***Study area****:* The study is carried out in the Central Brahmaputra Valley zone of Assam, situated in the center of the state Assam covering an area of 5524 sq. km. The valley occupied 7.04 percent of geographical area of the state. Administratively, the zone is comprised of two districts, namely, Nagaon and Morigaon. With a total population of 3783859 (in 2011) and a total land area of 5524 Sq.Km., the density stands at 685 persons per sq.km. The figure far outstrips the corresponding state figure of 397 and the national figure of 382. The rural population in the zone is 88.33 (2011 census) percent of the total population. About 62 percent of the total workers of Central Brahmaputra Valley are engaged in agricultural sector.

3.2 ***Study design*****:** The present study is based on data collected from secondary sources, collected from the publications of government agencies like, the Department of Agriculture and the Department of Economics and Statistics, the Government of Assam, Assam Agricultural University (Jorhat), District Agricultural Offices (Nagaon, Morigaon), Regional

Agricultural Research Station (Shillongani, Nagaon). Besides, different articles, journals and websites are also referred for the purpose. For data analysis, simple statistical tables and graphs are used. The growth rate of agricultural production and yield are calculated using the formula:

$$\frac{Yt-Yt-1}{Yt-1} * 100$$

covering an area of 5524 sq. km. The valley occupied 7.04 percent of geographical area of the state. The mighty Brahmaputra flows along the northern periphery of the zone. Southern part of the zone is surrounded by hill district of Karbi Anglong and the western and eastern side by Kamrup and Golaghat district, respectively. (Refer Fig-1) Administratively, the zone is comprised of two districts, namely, Nagaon and Morigaon.

4. RESEARCH FINDINGS:

The Central Brahmaputra valley zone is situated in the center of the state Assam

Fig- 1: Central Brahmaputra valley Zone of Assam

The 2011 Census report reveals that the rural population in Central Brahmaputra valley is 88.33 percent of the total population, for Assam it is 85.92 percent. About 62 percent of the total workers of Central Brahmaputra Valley are engaged in agricultural sector whereas for Assam as a whole about 52 percent of total workers depends on agriculture.

4.1 Shift in cropping pattern:

Table 1 reveals the change in cropping pattern (share of different crops in total cropped area) of major foodgrain crops in Central Brahmaputra Valley since 1970-71. Due to the absence of regular data on gross cropped area, total area under crops in the zone has been estimated by adding up the area under different field crops and excluded area under plantation and tree crops.

Analysis of area shifts across different crop groups suggested that during the 10 years from 1970-71 to 1980-81, the process of cropping pattern changes was slow and halting for total foodgrains. Foodgrains, which accounted for 77.11 per cent of the gross cropped area in 1970-71, still claimed 77.84 per cent of area during 1980-81. Where the share of area under wheat

increased from 0.52 per cent in 1970-71 to 3.27 per cent in 1980-81, the share of area under rice to total cropped area in the valley decreased from 72.1 per cent to 69.14 per cent. On the other hand, the share of area under total cereals and total pulses remained almost same during this period as shown in Table 1.

The proportion of area under foodgrains which had remained almost stagnant during 1970-71 to 1980-81, registered a sharp increase from 77.84 per cent of total area in 1980-81 to 82.63 per cent of total cropped area during 1990-91, and to 83.39 percent in 2000-01. This was mainly due to increase in share of area under total cereals (78.22) in 1990-91, and (80.38) in 2000-01. However, the share of area under total pulses declined to 4.39 percent and 3.01 percent in 1990-91 and 200-01 respectively.

During 2000-01 to 2009-10, share of area under foodgrains in Central Brahmaputra Valley zone has decreased from 83.39 percent (2000-01) to 81.78 percent (2009-10) due to decrease in area under total cereals from 80.38 percent to 78.35 percent.

The proportion of area under wheat production increased from 0.52 percent in 1970-71 to 4.13 percent in 1990-91, thereafter declined to 3.38 percent in 2009-10.

Table- 1

Shift in Cropping Pattern of Major Foodgrain Crops in Central Brahmaputra Valley Zone

(percentage of total cropped area)

Crop	1970-71	1980-81	1990-91	2000-01	2009-10
Autumn Rice	16.22	14.56	17.84	14.03	6.67
Winter Rice	55.16	51.45	42.75	41.72	41.69
Summer Rice	0.72	3.13	13.27	22.11	26.04
Total Rice	72.1	69.14	73.86	77.85	74.41
Wheat	0.52	3.27	4.13	2.29	3.38
Maize	0.08	0.22	0.17	0.13	0.13
Total Cereals	72.74	72.87	78.22	80.38	78.35
Gram	0.06	0.12	0.09	0.06	0.05
Tur	0.08	0.32	0.62	0.42	0.3
Total Pulses	4.37	4.97	4.39	3.01	3.42
Total Foodgrain	77.11	77.84	82.6	83.39	81.78

Sources: Directorate of Economics and Statistics, Government of Assam & Directorate of Agriculture, Government of Assam.

Thus, the analysis of the statistical data relating to area under different crops separately in Central Brahmaputra Valley Zone (Table-1) reveals that among the food crops, cereals constituted the dominant position and among the cereals, paddy is dominant. The soil, topography, rainfall and climate of the zone are congenial for agricultural activities mainly for the cultivation of paddy crops. Paddy cultivation occupies 74.41percent of total cropped area in 2009-10, which was 72.1 percent in 1970-71. However there was a gradual declining trend in area under autumn rice, which has switched over to the summer rice due to its higher productivity. The area under summer rice has increased from 0.72 percent in 1970-71 to 26.04 percent in 2009-10, whereas area under autumn rice has declined from 16.22 percent in 1970-71 to 6.67

percent in 2009-10 (Table-1). The area under winter rice, the principal kharif crop also declined from 55.16 percent in 1970-71 to 41.69 percent in 2009-10.

4.2 Decade-wise annual average growth rate:

The decade-wise annual average growth rate of area and production of major foodgrains in Central Brahmaputra Valley and Assam over the period of 40 years since 1970 is shown in Table 2 and Table 3 below. The growth rate has been calculated for five periods, 1971-80, 1981-90, 1991-2000, 2001-10 and 1971-2010.

The estimates of decadal growth rate of area and production reveals that the growth of production of total foodgrains in Central Brahmaputra Valley during the entire period 1971-2010 had increased by 3.65 percent, whereas the growth in terms of area had increased only by 0.74 percent. This might be because during the period, the average growth rate of productivity had shown an increase by 2.55 percent (Table 4). For Assam during this period the growth rate of area, production and productivity was 0.72, 2.54 and 1.7 percent respectively which was less than Central Brahmaputra Valley. The Central Brahmaputra Valley zone as well as the state as a whole achieved highest area growth rate of total foodgrain in the period 1971-80 (at the rate of 2.36 percent and 1.65 percent respectively). The growth rate of production in Central Brahmaputra Valley and the state as a whole during the same period was 3.94 and 0.76 percent respectively. It can be observed from Table 2 that area constituted to be the major component to increase production of total foodgrains during this period. The very low rate of production growth (0.76 percent) in Assam might be due to persistence of traditional form of agricultural technology, inadequate electrification and irrigation facility etc. After that the area growth rate of total foodgrains of the Central Brahmaputra Valley gradually declined in the period 1981-90 and 1991-2000 and showed shrinkage in area with trend rate of growth at (-) 2.86 percent during the period 2001-10. Growth rate of production of total foodgrains on opposite showed an increasing trend and became more impressive (8.09 percent) during 1991-2000. This was largely on account of high yield growth rate of 2.19 and 6.34 percent respectively. Albeit in case of area for the state as a whole also the same trend is found, the rate of growth and shrinkage was lower than Central Brahmaputra Valley. During 1991-2000, the growth rate of production for Assam (3.43 percent) was much lower than Central Brahmaputra Valley (8.09), which might be caused by much lower productivity growth rate (2.73 percent) than Central Brahmaputra Valley (6.34 percent). While, the growth rate of production of total foodgrains during all the sub periods till 2000 was higher for Central Brahmaputra Valley than the state as a whole, the difference became more prominent during 1991-2000. It was only during 2001-10, Assam attained higher growth rate of production of total foodgrains.

Table-2

Annual Average Growth Rate of Area (in percentage)

Crops	Central Brahmaputra Valley and Assam				
	1971-80	1981-90	1991-2000	2001-10	1971-2010
Autumn Rice	1.45 (0.77)	4.56 (1.46)	-2.08 (-1.16)	-8.8 (-4.75)	-1.28 (-0.96)
Winter Rice	1.96 (1.37)	0.39 (1.00)	0.71 (0.27)	-1.94 (0.01)	0.24 (0.65)
Summer Rice	24.1 (4.97)	11.32 (8.02)	16.63 (15.53)	-0.13 (3.1)	12.69 (7.98)

Total Rice	2.08 (1.24)	1.88 (1.22)	1.98 (0.73)	-2.94 (-0.47)	0.72 (0.67)
Maize	34.9 (7.85)	-0.01 (-1.27)	-0.09 (0.12)	-2.3 (-0.06)	5.82 (1.50)
Wheat	35.81 (27.88)	14.22 (4.78)	-4.98 (-1.7)	20.08 (-0.45)	15.78 (7.11)
Other Cereals and Small Millets	94.66 (31.85)	2.58 (-3.39)	1.01 (1.04)	2.41 (-4.69)	23.38 (5.55)
Total Cereals	2.35 (1.63)	2.25 (1.15)	1.60 (0.63)	-2.84 (-0.53)	0.8 (0.7)
Gram	19.05 (16.14)	6.19 (0.54)	-3.48 (-3.1)	-2.87 (-2.75)	4.36 (2.36)
Tur	21.33 (5.85)	15.72 (2.38)	-0.91 (0.41)	-0.22 (-1.35)	8.67 (1.72)
Other Rabi Pulses	3.34 (1.86)	1.48 (1.2)	-0.4 (0.55)	-1.6 (0.6)	0.64 (1.03)
Total Pulses	3.86 (2.22)	1.86 (1.18)	-0.66 (0.43)	-2.26 (0.4)	0.62 (1.03)
Total Foodgrain	2.36 (1.65)	2.14 (1.14)	1.47 (0.61)	-2.86(-0.5)	0.74 (0.72)

Sources: Directorate of Economics and Statistics, Government of Assam.
Note: Figures in the parentheses represent respective growth rate for the state as a whole.

In case of total cereals also the area growth rate for Central Brahmaputra Valley and Assam was highest during 1971-80 (2.35 and 1.63 percent respectively). Interestingly, difference in growth rate of production of total cereals between Central Brahmaputra Valley and Assam during this period was more than the difference in growth rate of area, which might be the result of productivity difference (Table 4). Area expansion of total cereals in Central Brahmaputra Valley slackened gradually in the period 1981-90 and 1991-2000 with trend rate of growth 2.25 percent and 1.60 percent per annum. Higher rate of growth of productivity of total cereals in Assam (2.77) than Central Brahmaputra Valley (2.05) during 1981-90 reduced the difference in growth rate of production. But the difference in the growth rate of production and productivity of total cereals between Central Brahmaputra Valley and Assam became impressive during 1991-2000, might be due to the difference in the adoption of new technology. It showed shrinkage in area and production of total cereals in Central Brahmaputra Valley at (-) 2.84 and (-) 1.65 percent per annum respectively during 2001-10. For Assam too the growth in terms of area had declined but at a lower rate than Central Brahmaputra Valley, whereas production had increased at the rate of 1.79 percent. It is important to note that the growth rate in area, production and productivity for total rice, total cereals and total foodgrains have shown almost similar pattern due to the fact that rice is the most important cereal crops which occupies more than 90 percent of the cropped area under total foodgrains.

Analysis of the trend rates of growth separately for the three types of rice suggests that although winter paddy was dominant in terms of area and production, rate of growth in production was more for autumn and summer paddy. Yield level also was relatively high for summer paddy. Area was the major component of increase in production of three types of paddy during 1971-80, since productivity growth rate was very low except for summer paddy in Assam. While the growth rate of area and production of autumn rice in Central Brahmaputra Valley as well as in the state picked up substantially during 1981-91 than the preceding sub period, the winter rice on the other hand showed opposite trend except for production in Assam during the same period. This increase in production of winter rice in Assam was largely on account of impressive growth rate of productivity (3.05) than Central Brahmaputra Valley (2.75), might be caused by higher growth rate of area under HYV winter paddy in

Assam during this period. Although area under autumn rice declined in both Central Brahmaputra Valley zone and Assam during 1991-2000, production showed a trend growth rate of 6.9 and 2.15 percent respectively due to considerable growth rate of productivity. Production of winter rice too during this period showed an increase though area remained more or less stagnant. It is interesting to note that the higher productivity growth rate of autumn and winter paddy during this period failed to increase area under the same. Decline in area and production of autumn rice became more prominent and sharp during 2001-10. Productivity growth rate of autumn rice in Central Brahmaputra Valley during this period declined more sharply than Assam, might be due to remarkable decline in area under HYV autumn rice (-13.63) in this zone. During the same period area under winter rice in Central Brahmaputra Valley declined but production remained stagnant whereas, area under winter rice in Assam remained stagnant but production increased.

Interestingly, summer paddy had shown marked improvement in growth rate of area under cultivation and production compared to other two paddy varieties. The first sub-period (1971-80) witnessed significant area expansion growing annually at 24.1 percent per annum in Central Brahmaputra Valley, which had declined to 11.32 percent during the second sub period (1981-90). But Assam showed opposite trend of increase in the area growth rate during the second sub period over the first sub period (Table 2). The period 1991-2000 recovered in the declining trend for summer rice in both Central Brahmaputra Valley and Assam. However, 2001-10 Central Brahmaputra Valley experienced stagnant situation with trend rate of growth although declining but low at (-) 0.13 percent. Production growth rate of it was impressive till 1991-2000, and became low during 2001-10.

Table-3

Annual Average Growth Rate of Production (in percentage)

Crops	Central Brahmaputra Valley and Assam				
	1971-80	***1981-90***	***1991-2000***	***2001-10***	***1971-2010***
Autumn Rice	4.49(-0.22)	9.44 (5.26)	6.9 (2.15)	-6.4 (-2.56)	3.58 (1.19)
Winter Rice	3.77 (0.32)	3.3 (4.25)	5.92 (2.16)	-0.35 (2.74)	3.14 (2.42)
Summer Rice	27.5 (11.3)	20.8 (13.1)	20.9 (21.7)	0.32 (3.12)	17.1 (12.34)
Total Rice	3.71 (0.2)	4.6 (4.42)	8.68 (3.54)	-1.66 (1.93)	3.84 (2.58)
Maize	25.8 (8.89)	-0.2 (-0.5)	3.41 (1.42)	-1.93 (0.04)	6.3 (2.3)
Wheat	75.2 (53.59)	12.9 (2.4)	0.58 (2.64)	39.69 (8.81)	31 (15.92)
Other Cereals and Small Millets	92.8 (30.47)	3.19 (-2.4)	1.1 (0.96)	2.34 (-4.92)	23.1 (5.41)
Total Cereals	3.97 (0.72)	4.34 (4.09)	8.25 (3.46)	-1.65 (1.79)	3.72 (2.56)
Gram	15.6 (13.38)	6.08 (0.35)	-5.6 (-1.9)	-2.31 (0.67)	3.12 (2.85)
Tur	21.2 (6.91)	15.6 (2.19)	-1.2 (0.57)	-0.15 (-1.19)	8.54 (1.99)

Other Rabi Pulses	4.57 (3.63)	1.17 (2.73)	1.74 (3.17)	-0.18 (0.69)	1.75 (2.53)
Total Pulses	5.34 (3.79)	2.23 (2.44)	0.64 (2.76)	-1.29 (0.47)	1.64 (2.33)
Total Foodgrain	3.94 (0.76)	4.27 (4.05)	8.09 (3.43)	-1.67 (1.75)	3.65 (2.54)

Sources: Directorate of Economics and Statistics, Government of Assam.
Note: Figures in the parentheses represent respective growth rate for the state as a whole.

Gains of area expansion for wheat in Central Brahmaputra Valley (35.81 % per annum) and in Assam (27.88 % per annum) during 1971-80 were much higher as compared to paddy. During this period production growth rate for wheat was also remarkable. Succeeding periods however disappointingly recorded a declining trend in the growth rate of area and production for both Central Brahmaputra Valley and Assam till 2000. Surprisingly, during 2001-10, when most of the foodgrain crops showed declining trend, wheat showed increasing trend.

Growth rate of area and production of total pulses of both Central Brahmaputra Valley and Assam showed declining trend consistently.

Table-4

Annual Average Growth Rate of Productivity (in percentage)

Crops	Central Brahmaputra Valley and Assam				
	1971-80	1981-90	1991-2000	2001-10	1971-2010
Autumn Rice	1.85 (-1.26)	4.16 (3.16)	8.78 (3.44)	2.27 (2.65)	4.32 (2.08)
Winter Rice	1.11 (-1.05)	2.75 (3.05)	4.94 (1.82)	1.39 (2.34)	2.58 (1.61)
Summer Rice	1.3 (6.2)	7.76 (3.67)	4.53 (4.91)	0.05 (0.14)	3.46 (3.67)
Total Rice	1 (-1.08)	2.53 (2.95)	6.34 (2.7)	1.19 (2.13)	2.81 (1.74)
Total Cereals	1.03 (-0.97)	2.05 (2.77)	6.34 (2.73)	1.03 (2.07)	2.65 (1.71)
Total Pulses	1.09 (1.48)	0.88 (1.3)	1.15 (2.25)	1.12 (0.04)	1.06 (1.26)
Total Foodgrain	0.91 (-0.95)	2.19 (2.73)	6.34 (2.73)	1.03 (2.01)	2.55 (1.7)

Sources: Directorate of Economics and Statistics, Government of Assam.
Note: Figures in the parentheses represent respective growth rate for the state as a whole.

Comparison of production growth rate of Central Brahmaputra Valley with that of the State average growth rate (Table 3) reveals that during 1971-80 the state lagged far behind in case of almost all the major foodgrain crops, which continued during 1981-90 with the exception of winter rice and pulses. However, albeit this difference Central Brahmaputra Valley and Assam experienced almost equal production growth rate of total foodgrains (4.27 and 4.05) during 1981-90. This was because winter rice which covers approximately 70 percent of total foodgrains production in Assam achieved higher area as well as productivity growth rate than Central Brahmaputra Valley zone during this period. During the period 1991-2000 however, among the foodgrain crops Assam recorded higher production growth rate than Central Brahmaputra Valley only in case of summer rice (marginally), wheat and pulses. But during this period, Assam experienced very low production growth rate of total foodgrains (3.43) than Central Brahmaputra Valley (8.09), might be due to very low productivity growth rate of autumn and winter paddy. The subsequent period,

however, witnessed a reverse situation where Assam recorded higher production growth rate in case of major foodgrain crops except wheat, tur, other cereals and small millets. During this period Assam experienced higher area and productivity growth rate in case of three types of paddy than Central Brahmaputra Valley zone.

5. CONCLUSION:

In Central Brahmaputra valley zone of Assam, area allocation among various crops has shown a measure of structural rigidity that reflects the traditional character of Indian agriculture wherein foodgrains have remained the predominant crop accounting for more than three fourths of the gross cropped area since the early 1970's. While, the growth rate of production of total foodgrains during all the sub periods till 2000 was higher for Central Brahmaputra Valley than the state as a whole, the difference became more prominent during 1991-2000. It was only during 2001-10, Assam attained higher growth rate of production of total foodgrains. the growth rate in area, production and productivity for total rice, total cereals and total foodgrains have shown almost similar pattern due to the fact that rice is the most important cereal crops which occupies more than 90 percent of the cropped area under total foodgrains. Analysis of the trend rates of growth separately for the three types of rice suggests that although winter paddy was dominant in terms of area and production, rate of growth in production was more for autumn and summer paddy. Yield level also was relatively high for summer paddy. Growth rate of area and production of total pulses of both Central Brahmaputra Valley and Assam showed declining trend consistently.

References:

Agarwala, A.K. and P. Hazarika (2004): *Developmental Disparities: A Quantitative Insight*, Akansha Publishing House, New Delhi.

Bezbaruah, M.P. (1994): *Technological Transformation in Agriculture*, Mittal Publication, New Delhi.

Bezbaruah, M. P. and N. Roy (2002), "Factors effecting Cropping Intensity and Use of Fertilizers and High- Yielding Variety Seeds in Barak Valley", *Indian Journal of Agricultural Economics*, Vol. 57, No. 2, April- June

Dhar, P. K. (2001), *The Economy of Assam, including Economy of North-East India*, Kalyani Publication, New Delhi.

Govind, N. (1986): *Regional Perspective in Agricultural Development*, Concept Publishing Company, New Delhi.

Lekhi, R. K. and J. Singh (1996), *Agricultural Economics*, Kalyani Publishers, New Delhi.

Mishra, S. K. and V.R. Puri (2009), *Indian Economy-Its Development Experience*, Himalaya Publication House, New Delhi.

Thirwall, A. P. (2003): "Growth and Development, With Special Reference to Developing Economics", Palgrave Macmillan, New York.

Yila, O.M., and G.B. Thapa (2008), "Adoption of agricultural land management technologies by smallholder farmers in the Jos Plateau, Nigeria", *International Journal of Agricultural Sustainability*, Vol. 6, No. 4, 277-288.