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Problems and Prospects of Hill Agriculture in India: A Review

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ABSTRACT

With rich land, abundant water and a favourable climate, hill agriculture in North-eastern region of India has considerable potential to grow and contribute towards improving farm incomes, enhancing food and nutrition security, reducing rural poverty and accelerating the overall economic growth of the region. Unfortunately the growth potential of hill agriculture has remained under-exploited due to lack of system-specific production technologies, poor infrastructure (transport, markets, processing) and underdeveloped institutions (credit, extension, information, insurance), inaccessible habitations, diverse socio-cultural and agricultural typologies and fragmented land holdings. The North-eastern region lying between 21.5^o N - 29.5^o N latitudes and 85.5^o E - 97.3^o E longitudes comprises of eight states - Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland, Tripura and Sikkim. It may be mentioned that in hill area particularly horticultural crop cultivation as an alternative to jhuming may prove to be a boon in the regional economy. In NEH region farming being the main stay of the people, development of horticulture will markedly improve the economy of the people. Establishment of orchards and planting of plantation crops on hill slopes will prevent soil erosion which may solve the problem of shifting cultivation and out migration of people to towns. The north eastern region is bestowed with the most congenial climatic conditions for the production of under-exploited agricultural and horticultural crops. These agricultural and horticultural crops also provide many fold employment opportunities in agro-based industries, packaging, storage, preservation, canning and transportation.

Key words: *Cropping System, Economics, Hill agriculture, NEH region, Soil erosion*

INTRODUCTION

With rich land, abundant water and a favourable climate, hill agriculture in India's north-eastern region, comprising states like Arunachal Pradesh, Assam, Meghalaya, Manipur, Mizoram, Nagaland, Sikkim and Tripura, has considerable potential to grow, and contribute towards improving farm incomes, enhancing food and nutrition security, reducing rural poverty and accelerating the overall economic growth of the region.

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Unfortunately the growth potential of hill agriculture has remained under-exploited due to lack of system-specific production technologies, poor infrastructure (transport, markets, processing) and underdeveloped institutions (credit, extension, information, insurance) not withstanding the structural constraints imposed by difficult terrains, inaccessible habitations, diverse socio-cultural and agricultural typologies, and small, scattered and fragmented land holdings.

The agricultural sector, including crops, animal husbandry, fisheries and forestry, contributed 26 per cent to the northeastern region's gross domestic product (GDP) in 2008-09, down by 11 percentage points than in 1993-94[4]. Its importance, however, transcends beyond its economic contribution. From the perspective of rural livelihood, agriculture remains an important economic sector despite its declining share in GDP. About 85 per cent of the region's population is rural, and majority depends on agriculture and allied activities, directly or indirectly during 2004-05, the agricultural sector engaged 56 per cent of the region's total workforce. The sector is dominated by small landholders, more than three-fourths of the land holdings size in the north-eastern region are less than or equal to 2 ha[5].

Traditionally, agriculture in the north-eastern states has been looked upon as a subsistence profession generating food for household consumption, ignoring its potential for commercialisation and growth. For instance, high-value crops such as, fruits, vegetables, condiments and spices occupy as much as 15 per cent of the region's gross cropped area, but lack of reliable and remunerative markets, and poor infrastructure restrict harnessing their growth potential. The region has considerable scope for enhancing agricultural growth if some of the technological, infrastructural and institutional constraints, which it confronts, are overcome[6].

In view of its potential in spurring economic growth and improving the livelihood of rural population, hill agriculture started receiving increasing attention of the policymakers in recent years [1, 3]. The North Eastern Region Vision 2020 places considerable emphasis on enhancing agricultural growth through technological change, area expansion and cropping intensity; and value- addition by attracting private investment in agro-processing[3]. However, to unlock the growth potential of agriculture, it is essential to have a better understanding of the past and potential sources of its growth, and target technologies and investment accordingly. In this paper, an attempt has been made to identify and quantify sources of agricultural growth in India's northeastern states. The results can serve as an empirical basis for designing appropriate policies and strategies for accelerated growth and enhanced rural livelihoods. The paper focuses on the crop sector that accounts for close to 70 per cent of the region's gross value of agricultural output.

OVERVIEW OF AGRICULTURE IN THE N-E REGION

This section provides a general background of the agricultural economies of the north-eastern states as to provide a context that could be useful in interpreting growth sources and drawing policy implications.

The northeastern region, comprising states such as Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura account for 8 per cent of the country's geographical area and 4 per cent of the population. Geographically, Arunachal Pradesh is the largest state in the region, but is sparsely populated (Table 1). Assam is the second largest state in area and houses about 70 per cent of the region's population. The region, in general, is characterised by uneven landscape, limited arable land, low population density, low urbanisation, poor infrastructure, low level of irrigation, high rainfall, low fertiliser use and low cropping intensity. There is, however, considerable diversity in these characteristics within the region.

The mean population density in the region is 148 persons per sq. km. of geographical area, ranging from 13 in

Arunachal Pradesh to 340 in Assam (Table 1). In most states, urbanisation is low (11-24 per cent), except Nagaland where close to half of the total population lives in urban areas. A majority of rural population in the region depends on agriculture and allied activities for its livelihood. Agriculture engages 56 per cent of the total work force. Dependence on agriculture is higher in Nagaland (68 per cent) than in any other state. The average size of land holding is less than 1.5 ha, except in Arunachal Pradesh and Nagaland.

The arable land is limited to only 18 per cent of the total land reported for use. This figure is as low as less than 5 per cent for Arunachal Pradesh and Mizoram. Only in Assam and Tripura, 30-35 per cent of the reported area is utilised for cultivation. The cropping intensity in most states, except Assam and Arunachal Pradesh is low, 104 to 120 per cent. Cultivation in the post-rainy season is restricted due to lack of under-developed irrigation infrastructure.

Agriculture in the northeastern region is mainly rainfed. Yet, the climate is favourable for cultivation of a wide variety of crops especially horticulture crops. The average annual rainfall in the region is 2300 millimeters, ranging from 1400 to 5500 millimeters across states. Most of it however is received during June-September. The normal temperature varies between 18°C to 32°C during summers and from 0°C to 22°C during winters. Land is fertile and water resources are abundant. The developed irrigated area is only 41 per cent of the ultimate potential. The hydropower potential is around 66,000 megawatts (which is about 40 per cent of the national potential) but the operating hydropower projects and projects under construction together constitute 6 per cent of the region's potential[2].

Adoption of improved agricultural technology is poor. An indication of this is the low intensity of fertiliser use. The average fertiliser consumption in the region is 41kg/ha. It is as low as 5kg/ha or less in Arunachal Pradesh, Nagaland and Sikkim, and does not exceed 60kg/ha in any other state in the region. The availability of institutional credit to the agricultural sector is estimated, as the amount of loan outstanding, is about Rs. 5400 per ha of net sown area. Road density varies widely across states; from 21 to 155 km 100 km^{-2} of the geographical area.

Agriculture and allied activities account for over a quarter of region's GDP, and their share has been declining (Table 1). Among the states the share of agriculture in GDP is the lowest in Mizoram (14 per cent) and highest in Nagaland (29 per cent), except in Nagaland where it has declined considerably since the early 1990s. The performance of agricultural sector in the region had been quite impressive during the past one decade or so (Table 1). At the regional level, the sector grew at an annual rate of 3.1 per cent, slightly higher than the national level of 2.8 per cent. In Manipur, Meghalaya, Nagaland and Tripura its performance was better than the national average.

With a share of 69 per cent in the gross value of output of the agricultural sector, crops comprise the most important segment. The share of crops, however, vary considerably within the region; 55-60 per cent in Manipur, Mizoram and Nagaland, 65-70 per cent in Arunachal Pradesh, Assam, Meghalaya, and Tripura, and 85 per cent in Sikkim.

The cropping pattern in the region[3] is dominated by cereals. Rice occupies more than two-thirds of the gross cropped area in Assam, Manipur and Tripura, and one-third to one-half in other states. Maize is also an important crop in Nagaland, Arunachal Pradesh, Mizoram and Meghalaya. The share of oilseeds is higher in Nagaland, Assam and Arunachal Pradesh than in other states. Pulses occupy around 3 per cent of the gross cropped area in most states except Nagaland (9 per cent) and Meghalaya (1.5 per cent).

Agriculture in most states is quite diversified towards high-value crops, that is fruits, vegetables, condiments and spices. These three crop groups together occupy about 15 per cent of the gross cropped area in the

region. Their share is 25-30 per cent in Arunachal Pradesh, Manipur, Meghalaya and Mizoram, and 10-20 per cent in other states. Tea plantation is also important in Meghalaya and Assam.

Table 1. Growth of agricultural sector of north-eastern states (per cent)

State	Share of agriculture in GDP		Annual growth rate in GDP	
	1993/94	2008/09	1993/94	GDP2008/09
Arunachal Pradesh	43.4	25.8	1.25	5.34
Assam	39.4	27.9	2.48	6.29
Manipur	35.5	23.6	3.30	5.80
Meghalaya	25.3	19.5	4.82	7.35
Mizoram	29.6	13.9	0.58	6.19
Nagaland	24.4	28.5	9.21	6.43
Sikkim	34.3	17.0	2.63	7.78
Tripura	35.3	22.4	4.84	8.67
Northeast	36.8	25.9	3.12	6.55

**Source: Estimated using data from National Accounts Statistics (www.mospi.gov.in).*

SOURCES OF GROWTH

In this section, we provide estimates of the (i) contribution of different crops to the overall growth of the crop sector, and (ii) relative contribution of area, yield, prices and land reallocation or diversification to overall growth.

First, we examine the composition and growth of the crop sector. At the regional level, rice contributes one-third of the total value of crop sector output, which is about half of its share in the gross cropped area (Table 2). Fruits, vegetables and condiments and spices together account for more than half of the total value of output of crops. In most states the share of these high-value crops is close to the regional average, except in Nagaland and Tripura where it is around 60 per cent. From a comparison of the value shares with area shares of these crops it is revealed that these generate larger returns to land as compared to cereals, pulses and oilseeds. Their relative profitability, however, varies across states due to differences in yields, prices and transport costs.

Table 2. Share of crops in gross cropped area, 2004-05 (Per cent)

Crops	State							
	Arunachal Pradesh	Assam	Meghalaya	Manipur	Mizoram	Nagaland	Tripura	North-east
Rice	42.8	65.9	35	69.5	52.1	42.2	70.1	61.5
Fruits	13.7	2.9	8.3	11.9	16.8	7.5	8.3	5.1
Vegetables	7.2	4.6	13.6	7.0	5.4	6.9	9.2	5.8
Condiments and spices	2.5	3.4	7.8	5.2	8.8	2.2	2.5	3.7
Other crops	0.0	2.4	3.5	0.3	1.1	0.7	1.2	2.1
All crops	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Estimated using data from *Statistical Abstract of India, 2007* (www.mospi.gov.in).

Table 3 also presents growth rates in the value of output of different crops. As a whole, the crop sector grew at an annual rate of 3.6 per cent during 1991-92 to 2003- 04. The rate of growth was higher for condiments and spices (7.3 per cent), fruits (5.5 per cent) and vegetables (4.5 per cent). The performance varies across states. Growth of crop sector was higher than regional average growth in Nagaland (15 per cent), Arunachal Pradesh (4.7 per cent) and Tripura (4.4 per cent). The *condiments and* spices grew faster compared to other crops in most states, except Assam and Arunachal Pradesh. Fruits were the second fastest growing crop group, except in Assam and Meghalaya. Rice too exhibited a very high growth in Meghalaya, Nagaland and Tripura.

Table 3. Share of different crops in the gross value of output during 2002-04 (per cent)

Crops	Arunachal Pradesh	Assam	ſeghalaya	Manipur	Mizoram	Nagaland	Tripura	North-east
Rice	27.2	33.6	20.2	51.2	38.9	17.9	37.4	32.5
Maize	6.6	0.1	1.6	0.6	3.4	4.4	0.1	0.8
Cereals	37.0	34.3	22.1	51.7	42.3	23.7	37.5	34.0
Pulses	2.7	1.3	0.7	0.9	4.0	6.5	0.9	1.7
Oilseeds	8.9	3.1	0.4	0.2	2.1	7.2	0.7	3.0
Vegetables	9.2	15.9	17.0	7.2	8.9	15.2	10.5	14.7
Fruits	31.9	20.1	25.5	32.1	28.6	31.1	42.3	24.5
Condiments and spices	10.6	13.1	11.7	7.6	12.8	15.6	6.5	12.2
Tea	0.0	10.4	21.9	0.0	0.0	0.0	0.5	8.5
Other crops	0.0	1.9	0.6	0.3	1.3	0.7	0.9	1.5
All crops	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

The purpose of this exercise is to identify crops or crop groups that have potential to contribute towards accelerating agricultural growth. The thumb rule for this is: promote crops whose share in the overall crop sector growth is higher than its share in the total value of output. Accordingly, fruits, vegetables and condiments and spices have emerged as the main drivers of crop sector growth. At the regional level, fruits contributed 40 per cent to the overall growth of the crop sector. Rice, vegetables, and condiments and spices each accounted for about one-fifth of the overall growth. Together, high-value crops accounted for 70-80 per cent of the crop sector growth in most states, except Meghalaya (61 per cent) and Assam (93 per cent). Rice is an important crop, but the value of output of fruits, vegetables and condiments account for 3.5 times more than the area share. The growth of condiments and spices was 7.3 per cent as against that 2.9 per cent for cereals[5; 8]. At the state level too, fruits remained an important driver of growth, except in Meghalaya. Rice was the main driver of growth in Meghalaya, and the second largest in Manipur, Mizoram and Tripura. Likewise, vegetables too were an important source of growth in Assam and Meghalaya but not in other states. The implication is that in the long-run, growth must result from yield-enhancing technologies and diversification of agriculture from lower- to higher-value crops. Policy implications of yield increases and diversification are not as obvious[9; 7].

Another way to decompose growth is by its source that is, due to area, yield, price and diversification. Table 4 presents decomposition of growth by these sources.The effect of prices on growth was negative in the case of cereals, oilseeds, condiments and spices and tea, and these explained about half of the growth in case of fruits and more than 30 per cent in case of pulses.

Table 4. Share of different crops in the annual gross value of output during 1991-2004 (per cent)

Crops	Arunachal Pradesh	Assam	ſeghalaya	Manipur	Mizoram	Nagaland	Tripura	North-east
Rice	1.8	2.6	6.8	1.3	3.2	4.2	5.0	3.0
Maize	1.7	1.2	1.8	-0.3	1.0	8.6	0.0	3.6
Cereals	1.4	2.6	6.2	1.3	3.0	5.2	4.9	2.9
Pulses	5.0	3.0	7.0	2.9	-5.7	14.4	-1.3	4.3
Oilseeds	-0.8	-1.2	-0.7	-6.3	-7.3	14.6	-11.0	-0.3
Vegetables	2.6	4.5	2.7	3.8	3.0	15.6	0.0	4.5
Fruits	11.7	4.2	0.7	5.1	5.5	25.5	5.9	5.5
Condiments and spices	8.9	2.0	10.3	15.1	9.9	31.1	9.5	7.3
Tea	NA	-0.4	0.9	-9.4	NA	NA	-5.1	-0.2
Other crops	NA	-3.3	-0.6	-7.4	4.1	-10.6	-6.0	3.4
All crops	4.7	2.8	3.7	2.5	3.3	15.0	4.4	3.6

The diversification column in Table 5 provides a change in the value of crop sector output due to land reallocation towards or away from that crop, holding other sources constant. Condiments and spices, fruits, maize, tea and pulses gained from land reallocation, while rice, oilseeds and other crops lost. Figures in the area expansion column show that almost every crop gained from the additional area brought under cultivation.

Table 5. Share of different crops in the annual growth sector during 1991-2004 (per cent)

Crops	Arunachal Pradesh	Assam	Meghalaya	Manipur	Mizoram	Nagaland	Tripura	North-east
Rice	13.1	26.1	40.7	30.5	36.2	7.3	28.8	23.0
Maize	3.0	0.0	0.9	-0.2	2.3	3.5	0.0	1.0
Cereals	15.6	25.7	41.0	30.3	38.5	12.1	28.1	23.9
Pulses	3.3	1.8	1.3	1.0	-8.4	6.5	-0.1	2.3
Oilseeds	-0.2	-3.0	0.0	-0.9	-6.4	7.4	-5.3	-0.7
Vegetables	5.0	31.8	27.0	9.5	7.0	15.7	5.1	22.3
Fruits	58.1	37.4	2.9	49.7	42.6	39.2	61.0	39.9
Condiments and spices	18.2	24.4	31.5	11.9	25.0	19.9	12.4	21.7
Tea	0.0	-16.4	-4.2	0.0	0.0	0.0	-0.4	-8.5
Other crops	0.0	-1.6	0.3	-1.5	1.7	-0.7	-0.9	-1.0
All crops	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

PROBLEMS RELATED TO SOIL EROSION

Normal erosion is a continuous process where soil is regenerated by natural means at the same rate as it is removed. But when protective vegetation is disturbed by cultivation, grazing or burning, the natural balance is upset and soil becomes exposed to most serious causes of erosion, i.e., water and wind. Under these conditions the soil can be washed away at a faster rate than it can regenerate resulting in a net loss of soil. It causes exposure of bed rocks and silting of rivers and dams. The main cause of soil degradation in the region is as follows.

SHIFTING CULTIVATION

It is known as *jhuming* and regarded as the step in transition from food gathering or hunting to food production. This traditional practice is still predominant in this region. In this system farmers burn the cleared vegetation and cultivate plots of land in the virgin forest until the yields of the crops fall below subsistence level. At this point the farmers abandon the land to natural fallow and move to a new site. Earlier when *jhum* cycle was long the abandoned land got time for regeneration of vegetation. Indiscriminate felling of trees on the hill slopes brought an undesirable eco-imbalance. Further, the hill tops are the main source of water; deforestation of this hill top led to the elimination of water source. This, in fact, ended in the loss of top soil. Coupled with this, deforestation drastically reduced the retentive capacity of the soil. Erosion of soil in the catchment area resulted in silting of the reservoirs and streams leading to unprecedented floods. Hence, this situation needs to be tackled on top priority to keep the ecological imbalance in tact as well as to meet the fodder, food, fuel requirements, etc., in these states. The calendar of shifting cultivation system is given in Table 6.

Table 6. Soil erosion calendar of shifting cultivation system

Month	Agricultural operation	Erosion problem	Soil erosion (t/ha)	
			Min	Max
January to April	Selection of plot, forest cutting, burning and cleaning of hill slopes and sowing begins	Displacement of loose soil materials to down hills and rolling down of earthworm casting, soil erosion as above and wash due to rains.	0.0	22.4.
May	Sowing/weeding	Heavy soil wash, faint drilling at foot hills on silt deposits	0.2	61.9
June	Weeding	Heavy wash of soil aggregates	0.2	45.4
July	Weeding/harvesting begins	Heavy wash of soil aggregates, crop root exposed, farm soil visible	1.8	21.9
August	Harvesting and occasional weeding	Soil wash continues	1.0	29.6
September	Harvesting	Moss appears, soil erosion slows down	0.1	13.8
October	Harvesting	Soil erosion appreciably reduced	0.0	2.7
November	harvesting	No erosion, moss turns blackish	0.0	0.0
December	Harvesting/threshing/carry harvest back to home	No erosion	0.0	0.0
Year	Cropping with zero tillage on steep slope	Heavy soil wash	3.3	201.4

The entire resource degradation process in the region is closely linked up with the land use system. Forestry is the most dominant land use system in the region followed by agriculture,

horticulture, animal husbandry and non-agricultural uses (urbanization, commercial establishment, etc.). Evaluation of some of the land use systems practices in the region indicates that most of them are hazardous to resources and are not conducive to the aims of permanent agricultural systems with sustainable production. Horticultural crops grown on the hill slopes without proper soil and water conservation resulted in soil erosion. The soil erosion varied with the extent of disturbances caused to the soil surface. Colocasia, tapioca, sweet potato, turmeric and ginger are the crops, which resulted in movement of soil to the foot hills during the process of harvesting.

CONCLUSION

Agriculture in the north-eastern region of India has considerable potential to grow and contribute to the overall economic growth and livelihood of the rural population. The climate is favourable to grow a wide variety of crops, particularly fruits, vegetables and spices. Lack of system-specific technologies, poor infrastructure and underdeveloped markets, however, restrict the realisation of true potential of agriculture.

Each of the growth sources has its implications for the agricultural research and development policy. However, sometimes the implications of these sources may not be as obvious, and require additional assumptions and information to derive policies and strategies. Keeping this in view we suggest the following strategies to harness the growth potential of hill agriculture in the north-eastern region.

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