CHAPTER EIGHT

SUMMARY AND CONCLUSION

The Brahmaputra valley is ecologically a homogeneous region with generally uniform physiography, temperature, rainfall, vegetation and soils. The production of crops in the region also presents wide similarity. The above stated parameters makes the valley easily identifiable from the neighbouring hilly areas and the Surma valley. The present study focusses attention on the possibilities of agricultural innovations in the valley, through proper farm management and rational utilisation of all available physical, human and economic resources.

Focussing our attention on land - the key resource which is capable of providing substantial returns in terms of food and industrial raw materials for regional economy, it would be relevant to throw light on the present land use pattern on the background of a numerically increasing population. Forests cover nearly 25 per cent of the total land area of the valley. At the district level, forests cover about 17.50 per cent of the total area of Nowgong district, and in Goalpara this figure is about 32.30 per cent. The forest cover is not uniform in all the districts of the valley. Further, the State Governments decision to open the village grazing reserves (VGR's), the professional

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1. Due to commercial exploitation of timber, a good part of the valley's forest resources have been depleted. This has largely upset the ecological balance of the region.
grazing reserves (PGR's), government waste lands, surplus tea garden lands and unproductive forest areas located in isolated patches, for settlement purposes, has encouraged the encroachers, specially from Bangladesh and Nepal, to colonise those lands without any valid authority. The Government's decision had several far reaching consequences. It is irrefutable that the grazing lands for cattle has decreased, with consequent decline in the quantum of natural fodder available for feeding livestocks. Also implicit in this is that the cost of maintaining livestocks increased. The more serious implication is that with the overall decrease of vegetation cover, due to deforestation and overgrazing of cattle, the problems of soil erosion - loss of valuable top soil in particular, and gully erosion took an undesirable turn. This was followed by the silting of river beds, and the volume of water discharged by the rivers declined. Consequently, when heavy rainfall occurs during the monsoon season, the rivers are unable to discharge the full load of water and detritus. The surplus water during monsoon, therefore, overflows the banks of the rivers and inundates the flood-plain areas.

The low-lying basins of the flood-affected areas are covered with large quantity of sediments. The layers of sediments which cover the fertile alluvial soils, renders those lands unfit for cultivation. These lands are termed as culturable wastes. The Lakhimpur district with dense net of

2. The bed of the Brahmaputra has risen by as much as 14 feet due to silting (Source: Indian Farming, Vol. XXXI, No. 12, March 1982, Indian Council of Agricultural Research, New Delhi, p.1).
rivers and inadequate flood protection measures has a large concentration of culturable waste lands, followed by Nowgong district. The Kamrup district has the lowest concentration of such lands. Furthermore, we find that the Brahmaputra valley has considerable fallow lands. In 1976-77, there were about 93,000 hectares under current fallows, and 97,000 hectares under other fallows. Fallow lands are infested by weeds which cover large areas annually. Quite often, the farmers leave the land fallow either for want of adequate supply of water, or in order to allow the soil to regain its lost fertility. But, this is an irrational step and an undesirable situation for an agrarian region.

Turning to agricultural lands, that is, net area sown, we find that it shares only about 41 per cent of the total geographical area of the valley. There is considerable spatial variation of the net area sown from one district to another. For example, only 27 per cent of the total area of Lakhimpur district and 55 per cent of Nowgong district is under net area sown. In the other districts, the figure varies between these two limits. Obviously, the net area sown is small and there is sufficient scope for reclaiming new lands and bringing them under cultivation.

The reclamation of culturable lands implies removal of weeds from the weed-infested areas, draining out the excess water from the water-logged areas by providing proper drainage channels and bunds where necessary. Provision for
supply of irrigation water, manures and fertilisers also have to be made in those lands which are barren and infertile. Any scheme of land reclamation is limited by the scope of capital investment. Admittedly, efforts should be made to engage the under-employed and the un-employed rural labour force in land reclamation works. Land reclamation schemes should preferably, function under the aegis of the Integrated Rural Development Programme (I.R.D.P.), and the workers engaged in land reclamation works should be paid in terms of foodgrains per manday employed. This will involve the active participation of the rural people in creating durable community assets. The reclaimed lands should be distributed to the actual cultivators, specially the small and marginal farmers and the agricultural labourers. Further, the government agencies like the Land Mortgage Bank, Agricultural Refinance and Development Corporation and other financial and technical agencies, should extend the necessary support to the people in carrying out cultivation on reclaimed lands.

In addition, the land tenure system in the valley has to be remodelled to meet the changing needs of the present agricultural situation. This is not to argue that the present land tenure system is defective, but, it generally does not encourage perpetual agricultural transformation in the valley. In 1975, the ceiling on individual holdings was placed at 50 bighas. All surplus lands above this limit was to be acquired and distributed among the landless people viz. the
farmers', tea-garden labourers, flood and erosion affected people and immigrants from Bangladesh. Due to certain inherent lags, effective implementation of the policy was not completely possible (Chapter -4). The State Government's willingness to abolish intermediaries in land rights and update the Record-of-Rights is appreciable, for only then, the tenants will feel more secure over the land possessed by them. It should be stressed here that modernisation of farming methods is incompatible with slow pace of land reforms. However, the above observations do not ipso facto means that agriculture has been neglected, but, a more realistic approach to tackle the problems of land reforms and agricultural innovations is urgently required.

It may rightfully be claimed that agriculture is the sole occupation which engages a large chunk of the valley's rural population. Admittedly, the fertile lands of the Brahmaputra valley has always lured the indigenous people to take up agriculture. Besides, the empty virgin lands have always attracted the land hungry immigrants from neighbouring countries, since the early part of this century. The immigralional effects have not only altered the demographic structure, but have accentuated the human population pressure on land. Consequently, the man-land ratio steadily declined, for the immigrants have made deep inroads into all available empty lands, including the 'chor' areas of the Brahmaputra. This phenomenon has to be assessed in the context of the natural population growth in the valley.
Evidently, to supply the growing population with food, raw materials and employment, the agricultural sector has to play a vital role, because of its substantial growth potentials. In this situation, the land utilisation and management practices has to be oriented on modern and scientific lines.

Agriculture is by and large a seasonal occupation in the Brahmaputra valley, and caters mainly to the subsistence needs of the farmers. This is so, because, crop production is controlled by the seasonal distribution of monsoon rains. In 1976-77, the intensity of cropping in the valley was about 123 per cent, as against 119 per cent in the country. At the district level, the intensity of cropping varied between 107.81 per cent in Sibsagar - the lowest, to 137.76 per cent in Kamrup - the highest. Four districts viz. Goalpara, Kamrup, Darrang and Nowgong had intensities above the valley’s average, and three districts viz. Sibsagar, Dibrugarh and Lakhimpur had intensities below the valley’s average (Chapter -4). It is true that the districts with high population density and limited arable land generally have high intensity of cropping. Also, it is justifiable to note that when the per capita holding size is large, as in Sibsagar and Dibrugarh districts, the intensity of cropping is low. And, when the per capita holding size is low, as in Kamrup district, the intensity of cropping is high. At this stage it may be noted that during the seven year period from 1969-70 to 1976-77, the intensity of cropping declined from 124.13 per cent to 123.21 per cent. This marginal decline may
be attributed to the fact that during the said period, there was little attempt on intensification of agriculture; even though the net area sown increased from 1956 thousand hectares to 2309 thousand hectares. Non-intensification of agriculture may be partly due to non-availability of agricultural inputs and poor infrastructural background vis-a-vis power shortage and lack of irrigation for growing rabi crops.

The intensification of agriculture is a prime necessity today. The farmers of the valley should divert their attention from the present practice of mono-cropping to raising two or more crops in a year, from the available land base. In 1976-77, the double cropped area (536 thousand hectares) covered only about 23 per cent of the net area sown (2309 thousand hectares). District-wise, Sibsagar has only 7.8 per cent (the lowest) and Kamrup 38 per cent (the highest) share of their respective net area sown under double/multiple cropping (Chapter-4). Here, it may be argued that the low hectarage under double cropping can be substantially increased by proper utilisation of the available surface and ground water sources. In 1977, the valley had about 2,72,240 hectares of land under irrigation. The Darrang district had the lion's share, that is, about 31 per cent of the valley's total irrigated land, but, the Lakhimpur district shared only 0.61 per cent in this respect. It is agonising to note that even the meagre irrigation facilities which covers about 9.60 per cent of the gross cropped area
of the valley are not spatially evenly distributed among the districts. For, about 87 per cent of the valley's total irrigated area is confined to Goalpara, Kamrup, Darrang and Nowgong districts, leaving the remaining 13 per cent to be shared by Sibsagar, Dibrugarh and Lakhimpur districts. At the same time, it should be noted that about 75 per cent of the developed irrigation facilities are available in the kharif season, leaving the balance 25 per cent for the rabi season (Chapter 4). This amply shows that bulk of the irrigation is done in the kharif season, when rain water is sufficient for crop production.

Considering the tremendous potential of ground water resources (9480 million cubic metres), its easy availability at shallow depth from the surface, the ease and feasibility of installing numerous ground water structures, it would be in the fitness of things to go for a massive programme of ground water development (Chapter 6 Water Potential). Moreover, the utilisation of ground water resources offers several advantages in terms of water-cum-land management for crop production, at all seasons of the year.

Whereas, irrigation water is essential to wipe out the deficiency of water in the rabi season, and occasionally in the kharif season, yet, the other essential ingredient for intensifying agriculture and raising productivity is fertiliser. The consumption of chemical fertilisers in the valley is abysmally low (Chapter 6 Land Potential). The
application of organic manures too, is far from satisfactory. This is a discordant situation in the valley, because it receives heavy rainfall and the vital plant nutrients are perpetually washed away. Another distressing feature is that the farmers feel, once chemical fertiliser is used, the quantum must be increased year after year to get the usual returns. Otherwise, the soil loses its fertility and becomes incapable of giving sufficient returns.

Another cause of low consumption of fertiliser is that due to quota limitation in allotment of railway wagons, the State government cannot lift the allotted quantity of fertilisers from factories outside the State in time. This leads to short supply of the chemical fertilisers in the State. It may also be instructive to state that, adequate number of godowns and storage facilities are not available for storing the fertilisers for at least two or three months, before supplying it to the farmers. At present, the Hindusthan Fertiliser Corporation (H.F.C.) has the following warehousing capacity.

<table>
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<tr>
<th>Serial No.</th>
<th>Centre</th>
<th>Capacity (in tons)</th>
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<tbody>
<tr>
<td>1.</td>
<td>Bongaigaon</td>
<td>100</td>
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<tr>
<td>2.</td>
<td>Dhubri</td>
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<td>3.</td>
<td>Maligaon</td>
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<td>4.</td>
<td>Tempur</td>
<td>300</td>
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<td>5.</td>
<td>Kharupetia</td>
<td>200</td>
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<td>6.</td>
<td>North Lakhimpur</td>
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<td>7.</td>
<td>Tinsukia</td>
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<td>8.</td>
<td>Dergaon</td>
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<td>9.</td>
<td>Jorhat</td>
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The foregoing table shows that the total warehousing capacity of the H.F.C. is about 2,550 tons. The storage capacity is thus, limited. Non-availability of fertilisers has been magnified by the poor system of fertiliser marketing facilities. As such, even those farmers who are willing to apply fertilisers to their land, for raising the yield, or increasing the cropping intensity have to remain contended with total non-availability, or insufficient availability of this vital agricultural input. It may also be referred that the only State Fertiliser Factory at Namrup produces only nitrogenous fertilisers viz. urea and ammonium sulphate. For supply of phosphates and potassic fertilisers, the valley has to depend on sources, from outside the State.  

But, even if the fertiliser availability in the valley improves considerably as a result of governmental efforts, the consumption is not likely to increase simultaneously. Perhaps, this is because, for augmenting fertiliser application to crops, much demonstration and extension work has to be done at gaon panchayat and block levels. It is a commonly shared view that unless fertilisers, pesticides, 

3. It should be noted that potassic fertilisers are not produced in India, and is wholly imported from outside sources.
insecticides, high-yielding variety seeds, farm implements, irrigation and credit facilities are provided to our farmers at subsidised rates, at the proper time, at the right place and in sufficient quantity, the farmers are not very likely to adopt modern and improved cropping practices. Consequently, this may be detrimental to the spread of hybrid varieties, and will retard the pace of geographic spread of multiple cropping practices in the Brahmaputra valley.

Looking into the pattern of crop productivity, it is eventually felt desirable to make suitable rearrangements in the cropping pattern, if we are to associate our agriculture with a higher growth rate. It is thus explicit that, crops with low yield and high spread, have to be replaced by those with high yield but presently having low areal coverage (Refer Chapter-5 Efficient and Inefficient areas of crop production). Here, it may be reasonable to put forward some viable alternatives to change the existing cropping pattern at the district level. These suggestions may not be presumptuous enough, though, it will predict the future requirements in respect of agricultural innovations in the valley.

Essentially then, in the Goalpara district, more lands can be devoted to jute cultivation, in place of winter rice which is proving to be unproductive. Attempts should also be made to increase the area under wheat which gives high yield in the district, and this is aided by the optimal
temperature, moisture and humidity in the winter months. Obviously, the loss of area under foodgrains, by curtailing the area under winter rice in the summer season, will be compensated by growing more wheat in the rabi season. Even from the point of nutritional diet, wheat is more nutritious as a food item than rice. Wheat cultivation on a wider scale will enhance the food resource base of the district, and it will be possible to supply the cereal to other needy areas of the valley. Tur and maize cultivation can also be done on a wider scale. The area under papaya cultivation can also be increased considerably, at the expense of area under coconut which appears unremunerative.

The preponderance of different kinds of cash crops in Kamrup district is significant. Yet, there are certain crops like rapeseed and mustard, cotton, and tapioca which do not seem to favour well there. Like Goalpara, this district also has bright prospects for undertaking wheat cultivation on a massive scale, specially in areas which are devoid of the effects of water-logging. This is essential, because of the poor performance of summer rice. Even sugarcane cultivation can be done on larger areas, by removing cotton from the cropping pattern of the district. At the same time, coconut and sesame cultivation can be increased at the expense of the area currently under papaya, rapeseed and mustard. The cultivation of autumn rice also needs to be intensified.
In the Darrang district, there is a mixed cropping pattern with considerable area under food and cash crops. Most of them seem to favour well in the district. Among the food crops, only summer rice does not seem to favour well in the district. It is therefore, felt desirable that wheat cultivation is made to replace summer rice. On the other hand, jute and sugarcane which have low yields inspite of their high spread, should be replaced by more competing crops like winter rice, tobacco and mesta which will yield better returns in the long run.

In the Nowgong district, which can be called the "rice bowl" of the Brahmaputra valley, the existing hierarchy of crop acreage can be maintained. But, attempts should be made to innovate new agricultural techniques and cropping practices which will make it possible to increase crop yields significantly. In addition to rice, wheat, jute and sugarcane are the major crops which offers considerable scope for development there.

In the Sibsagar district, it would be a positive step towards agricultural improvement, if the unremunerative crops are replaced by more viable crops. For instance, the area under tobacco can be switched over to wheat and oilseeds. The area currently under potato, mesta and coconut can be devoted to more suitable food and/or cash crops like maize, banana, arecanut and cotton.
The Lakhirnpur district has considerable share of area under crops with high yield. Nevertheless, the inefficient crops like papaya, tapioca, sesamum, potato and gram pulses should be replaced by rapeseed and mustard, tur, arecanut, cotton, banana, and sweet potato. This will help to strengthen the agricultural resource base of the district.

The crops grown in the Dibrugarh district are highly efficient on an overall basis. Inevitably, with the object of enhancing the agricultural base of the district, the few crops which are inefficient can be substituted by those which have shown better performance. It would perhaps, be wise to dispel coconut cultivation. On the other hand, arecanut cultivation can be further extended. The cultivation of summer rice can possibly be increased as well.

On the whole, the cropping pattern in the valley has to be restructured, by replacing the inefficient crops by more efficient ones, at the district level, and eventually in the subdivision level. This will enhance substantially the prospects of stable agricultural production, and ensure the viability of new cropping patterns. It is probably an indisputable fact that, by clinging on to the existing cropping practices, the farmers in the valley have inhibited agricultural transformation, and this has reduced the payoffs from the agricultural sector in general. In order to pursue the farmers to change the cropping pattern, it would be desirable to supply adequate quantity of agricultural
inputs to them. Besides, provision has to be made to demonstrate the viability of adopting new crops and cropping patterns among the prospective farmers. Simultaneously, the marketing facilities in the rural areas should be considerably improved. In fact, the lack of market speculations on the part of the farmers, has inhibited structural changes in the cropping pattern in the valley in general.

PRODUCTION TENDENCY ANALYSIS:

Presently, it is found that most crops grown in the valley give low yields compared to the national averages, not to speak of the higher yields obtained in the agriculturally advanced States of Punjab, Haryana and Tamil Nadu. The low yield rate of crops in a predominantly agricultural region like the Brahmaputra valley is agonising for the farmers and agricultural planners alike. The compound rates of growth in area, production and yield of a few selected crops are shown in Appendix-VIII. The average yields of those crops over three two-year periods, that is, 1955-56, 1966-67 and 1978-79, as also the percentage change in yields are shown in Appendix-IX. From the appendices VIII and IX it is seen that, between 1955-56 to 1965-66, autumn, winter and summer rice, sugarcane, potato, rapeseed and mustard showed an increase in area. The per annum compound growth rate has been the highest in case of summer rice (15.9 per cent) and lowest in winter rice (only 0.5 per cent).
In the production side too, summer rice showed highest increase (10.2 per cent per annum), whereas, potato showed a decrease by -6.2 per cent. Further, the yield rate showed a negative growth. Only sugarcane recorded a compound growth rate of yield by +2.9 per cent per annum.

During the subsequent period, that is, between 1966-67 and 1978-79, except jute which indicates negative growth in area devoted to it, the other crops viz. autumn, winter and summer rice, wheat, sugarcane, potato, rapeseed and mustard recorded an appreciable growth rate of the area devoted to them. The highest increase in area has been in the case of wheat (23.5 per cent), followed by summer rice, sugarcane, rapeseed and mustard, potato, autumn rice and winter rice in that order. In the production side too, wheat (28.8 per cent) showed the highest growth rate. It is followed by summer rice and potato respectively. However, sugarcane witnessed a decline in production by -0.5 per cent. It is however, paradoxical, that the yield rate of most crops increased only marginally. It varied between +3.8 per cent in the case of wheat to +0.2 per cent in case of summer rice. The yield rate of sugarcane showed a decline by -0.6 per cent per annum.

It is perhaps, in the fitness of things to state that the increase in area of crops was significant, and the increase in production was due to additional area being brought under cultivation. The yield rate of crops, however,
has not kept pace with the increase of area devoted to them. Proper focus should be laid on raising productivity. This involves a proper analysis of a whole array of complex factors involving man-land relations, availability of basic agricultural inputs and other necessary infrastructural facilities.

AGRICULTURAL MANAGEMENT:

The agricultural landscape of the Brahmaputra valley is dotted with numerous operational holdings totalling 20,25,745 (Source: World Agricultural Census on Assam, 1976-77). In 1970-71, the Kamrup district had the largest share of operated holdings (about 22.5 per cent of the valley's total holdings), and the smallest share was in Lakhimpur district (5.72 per cent). Further, even from the point of operated area, Kamrup district which shared only about 20 per cent occupied the first place, and the least share went to Lakhimpur district (a little over 6 per cent). On the whole, the three upper valley districts of Lakhimpur, Dibrugarh and Sibsagar with about 28 per cent of the total operated holdings of the valley, had nearly 35 per cent of the total operated area. Those districts are better placed so far as the number of operational holdings and operated area are concerned. In 1976-77, the average size of an operational holding in the valley was 1.32 hectares. This figure is as high as 2.01 hectares in Dibrugarh district, and as low as 1.12 hectares in Darrang district. No doubt, small holdings,

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that is, holdings below 2 hectares size, dominated the agricultural scene in the valley. Darrang and Nowgong districts, for example, had 86 per cent and 82 per cent of their holdings below 2 hectares size respectively. The position in respect of other districts is not much better than this.

It is also interesting to note that in 1970-71, of the total operated area, about 83.73 per cent was owned land and the balance 16.27 per cent was rented land. In Sibsagar district, about 92.54 per cent of the total operated area was owned land, and in Lakhimpur, owned land shared only 65.89 per cent of the operated area of the district. These two districts also had the lowest (7.46 per cent) and the highest (34.11 per cent) of their total operated area under rented land category respectively. The mode of payment of rent on rented lands varies widely (Chapter -7 Organisation of holdings). Moreover, considerable area of government land is under forcible occupation by settlers.

The two preceding paragraphs does not reflect the true position in respect of farm management in the Brahmaputra valley. However, a field survey conducted by the Planning and Development Department, Govt. of Assam, reveals that with the increase of holding size, the family size also increases (Refer Chapter-7 Family size and farm size). The spatial distribution of farms reveals that, those farms located close to the urban centres were of smaller size than those
farms located farther away. The apparent variations in farm size could be due to variations in population density. More specifically, areas lying close to the urban centres have high density of population vis-a-vis those areas lying farther away. The smaller farms have easy accessibility to the urban market centres and this provides an incentive to the owners of such farms to produce food and cash crops, which are easily disposed off in the urban markets. On the other hand, a substantial part of the larger farms are devoted to the production of perennial crops. Those produces are marketed in the village site itself, due to remote geographical location which prevents easy and direct access to the markets located in the urban centres.

The Brahmaputra valley is known for the preponderance of small and marginal farmers over the large farmers. Also, bulk of the holdings are small (below 2 hectares each) in size. Obviously, farm management policies/decisions should focus attention on those tiny farms, which forms the base for large scale agricultural innovations in the valley. Admittedly, most of the small farmers are purely subsistence farmers, who carry on farming as a family tradition. Paddy is the main crop grown by them and the cash returns from the crop is not economically remunerative; because, bulk of the produce is consumed by the family members and very little surplus is available for selling in the market. The cash income of the farmers is, therefore, meagre. This is
obviously seen among the small farmers, who do not have the advantage of utilising irrigation water for crop production. However, in the case of small farmers with assured irrigation, the effective land resource base increases, as with reliable and controlled water supply, multiple cropping can be undertaken. This raises the prospects of intensifying agriculture and makes them economically viable farm size.

But, it must be noted that mere availability of irrigation water is not by itself an essential, but indispensible condition for modernising our agriculture. As for instance, it may be stated that in the command area of the Jamuna irrigation project in Nowgong district, farm Modernisation was at its lowest ebb, inspite of the availability of irrigation water. This is amply clear from the poor utilisation of inputs like high-yielding varieties of seeds, fertilisers, pesticides etc, even though a considerable part of the land is under double cropping. It is but, appreciable that the proportion of double cropped area to gross cropped area is high in small farms, which invariably have a relatively larger part of their land under irrigation vis-a-vis large farms. It is also pertinent to note that with the increase of holding size, the percentage of irrigated area to total cultivated area declines (Refer Chapter -7 Farm Management). This reveals

5. It may be noted here that large farm sizes/holdings have a considerable share of land under fallows.
that the farmers owning large holdings have their lands in different parcels/fragments, where irrigation water cannot be conveniently distributed from the source/terminal. This is one of the drawbacks of canal irrigation system. Of course, since the large farmers obtain large aggregate returns from their holdings, they are less inclined to raise crop yields substantially. Furthermore, the large farmers lease out a part of their holdings to other small/medium farmers, or landless labourers. The tenants who cultivate on such leased-in land are least conscious of rational land management and/or water utilisation practices because, the gains, if any accrues largely to the land owners.

It is here that farm management practices needs a thorough scrutiny in order to promote balanced agricultural development in the valley. Although, any generalised pattern for agricultural development cannot be postulated, yet, the various farm sizes may be conveniently grouped together for rational organization and utilisation of the available physical, human and economic resources. In those farms which are below 2 hectares size, the adoption of multiple cropping practices is essential, to make more effective utilisation of the available land base. For improving the management of those farms from the economic viewpoint, the cultivation of paddy should be replaced by, or rotated with crops like sugarcane, jute, pulses, oilseeds etc which fetches more and direct cash income for the farmers. In large farms, say
above 2 hectares size, ideal farm management requires optimum utilisation of water available from irrigation sources, and raising the yields of crops per unit of land and labour employed. Concurrently, the production of food crops on large farms should gain precedence over the production of other crops.

In order to make farm management effective and meaningful, the mechanisation of farm operations also needs conjunctive attention alongside irrigation development. In the small size farms, the use of 'intermediate technology' should supplement the traditional methods of cultivation (Chapter -6 Labour Potential). This will permit the small farms an opportunity for intensive agriculture, by fuller utilisation of the available resource endowments and adoption of multiple cropping system. In the large farms, say above 3 hectares size, the counter balancing effect is that, due to the availability of cheap immigrant labourers the modernisation of farms will be invariably inhibited. This is disappointing, because, the large farmers make scanty use of modern agricultural inputs and technologies to raise production levels in their holdings. This is inevitable on their part, so long as they can invest little on labour inputs, and realise sufficient returns - in cash and kind, from their large holdings. Such operational tactics on the part of the large farmers is detrimental to the agricultural transformation vis-a-vis raising the quantum
of production from such farms. Mechanisation of farm operations in large holdings, too has been slow. In fact, the recruitment of cheap immigrant labour for farm work should be discontinued so that farm mechanisation/modernisation process is not retarded. Of course, it is an admitted fact that very little demonstration, on the use of modern farm implements and machineries has been done by the State Agriculture Department. Also, farm equipments are not easily available to our farmers, and facilities do not exist for repairing and servicing the implements in most of the villages.

The volume of input and output patterns in the farms, based on the author's field study, carried out in the valley, reveals that the farmers invest small amount on money on their land to realise/obtain sufficient returns, in terms of produce. It might be useful to state here that, due to the poor economic conditions of most farmers in the valley, the application of modern inputs is strikingly meagre. Nevertheless, in unirrigated farms, the cost of supplying inputs was found to be more on large farms, followed by the small and medium ones respectively (Chapter -7 Input-Output Analysis). Concurrently, it was found from field study that the per capita gross income was the highest (Rs. 692.10p) in large farms (above 2.01 hectares), then came the small farms (Rs. 475.43p), and the medium ones (Rs. 470.24p). The fact that, medium farms which supports more family members, and therefore,
have low per capita gross income also indicates why the amount of investments on inputs is low in such farm sizes.

There is no doubt that the big farmers because of their greater bargaining advantages have easy access to credit and other inputs, but unfortunately, they have made only a marginal use of such facilities, vis-a-vis the small and marginal farmers. Still then, the bigger farms show higher yields of crops than the small and medium ones (Refer Chapter -7 Table-13). Under the present conditions, it may be noted that with the increase of family size, the average income per household also increases. Bigger farms support large family members, and more labour is available for carrying on the farm operations (Chapter -7 Family size and gross income). It should be understood that farm management in the Brahmaputra valley is still in its infancy. No proper assessment has yet been made of the available resource potential, and therefore, a broad base on which agricultural schemes can be formulated, is generally absent. Some of the drawbacks in the sphere of agricultural transformation in the Brahmaputra valley, and the possibilities of removing regional imbalances in agriculture and its concomitant economic development are noted below.

Agricultural scientists and planners may take note of the fact that agriculture provides direct livelihood to a large number of workers in the valley. Of the total workers (33,05,081 persons) in 1981 (estimated), over 60 per cent
are engaged in the agricultural alone. The fact that agriculture and other primary activities provide livelihood to a large number of persons, is probably a good indication that the secondary and tertiary sectors are less developed. Justifiably then, the economy of the valley is not diversified to the desired extent. This is a paradoxical situation for a region endowed with a tremendous potential of different natural resources. In the light of the above considerations, there is an urgent need for analysing the potentials and difficulties of agricultural development in the valley.

Annually two to three flood waves create havoc in the valley. Floods have a beneficial side effect too, for the flood water bring huge quantity of fine silt and clay, and this helps to replenish the soils of the valley by natural process. This makes it easier for the farmers to grow crops on their land base without the application of manures and fertilisers from external sources.

In the monsoon season, water is quite sufficient for growing kharif crops. However, there are occasional failure of rains and unusual drought spells. During the drought period, the farmers cannot utilise the entire farm land and as a result, agricultural production falls. It is observed that the districts of Goalpara, Kamrup, Nowgong and Lakhimpur face more frequent drought situations, in comparison to other districts viz. Darrang, Sibsagar and Dibrugarh. In the last named three districts, the variability
of rainfall is low, and hence greater is the reliability
(Chapter - 1 Variability of Rainfall). It may also be stressed
here, that the three parameters, that is, rainfall,
temperature and relief act independently of each other in
the valley. Basically, the climate of the valley is the
sole creation of the air masses and pressure cells which
frequent the valley with wide spatio-temporal intensities.
Incidentally, the climate of the valley is homogeneous, though,
there persists identifiable variations in the climatic
pattern at different seasons of the year. The distribution
of different weather phenomena also makes the Brahmaputra
valley easily distinguishable from the neighbouring hilly
areas. Accordingly, over 90 per cent of the annual rainfall
is concentrated in the monsoon season. Fogs occur in winter
and thunderstorms are frequent during the pre-monsoon
season. These weather hazards, as also, the floods, in
particular, exert their combined role in affecting
agricultural production in the valley.

Ironically, the weather hazards cannot be overcome,
but, the havoc wrought by floods and droughts can certainly
be minimised. Occasional moisture deficit can be overcome
by proper utilisation of the ground water resources. But,
floods are a perennial ordeal during the rainy seasons, and
at the same time unavoidable. Nonetheless, the problem has
engaged the attention of the State and Union Governments
since the dawn of the planning era in 1950-51. Several short
and long term remedial measures have been initiated to control floods, such as, construction of embankments along the Brahmaputra and its major tributaries at vulnerable points, construction of drainage channels and sluice gates on the tributaries of the Brahmaputra to regulate the flow of water in the flood and lean periods, and other town protection measures. To carry out these schemes more effectively, the Brahmaputra Flood Control Commission (B.F.C.C.) was constituted in 1970.6

Subsequently in 1981, the Brahmaputra Board was constituted under an act of the Parliament. The aims and objectives of the Board include preparation of Master Plan to make the best use of the water resources of the Brahmaputra basin. The plan envisages flood and erosion control, development of irrigation and navigation facilities and generation of hydro-electric power. An outlay of Rs. 2 crores has been provided to the Board to meet the initial expenditures.7 Considering the dimensions of the problems of flood control, and the imperatives for utilising the surface water resources to the best advantage of the valley, the financial and technical constraints should be suitably overcome. If necessary, aid should be sought from foreign agencies. To supplement the efforts made by the flood control

6. The B.F.C.C. functions under the administrative control of the Govt. of Assam and its functions are directed by the Brahmaputra Flood Control Board.

department, the indigenous technology (such as construction of bamboo porcupine spurs, dykes etc) as adopted by the farmers' should be investigated for better scientific improvement. Moreover, if proper training or demonstration is provided, then a large section of the cultivators would be benefitted.

Simultaneously, other measures should be initiated in cooperation with the local people. These include checking overgrazing of cattles on grazing land and forests beyond the actual carrying capacity of such lands, and preventing careless irrigation system and embankment construction along the wrongly aligned drainage channels. On the other hand, afforestation schemes have to be carried on more vigorously in the catchment areas of the Brahmaputra basin. Obviously, social forestry schemes which form an integral component of afforestation should engage the whole-hearted cooperation of the local people. Growing fast maturing varieties of trees to provide a protective vegetation cover to the soil, and cheap supply of fuel wood to the people on a selective basis should receive prompt attention.

Regardless of the measures taken for flood control, there is yet one more way to minimise its impact on agricultural lands. This implies reorienting the cropping pattern on more viable lines. The farmers should lay emphasis on growing early maturing kharif crops during the monsoon season, which can be conveniently harvested before the onset of the flood.
waters. Subsequently, after the flood water recedes, suitable rabi crops should be grown. Prior to altering the cropping pattern, the identification of the chronically and occasionally flood prone areas is essential. As a part of the cropping strategy in flood-affected areas, the following crop rotations may perhaps be useful in minimising the effects of floods. The cultivation of high-yielding varieties of 'ahu' paddy like Bala and Pusa 2-21 should be undertaken, which can be harvested before the onset of the monsoon season. In the post-monsoon season, the cultivation of 'sali' paddy like Jaya and I.R.8 should be undertaken. In the rabi season, oilseeds, pulses, wheat, maize, potatoes and vegetables can be cultivated on a large scale, on the identified areas, having favourable environmental conditions.

In areas where moisture supply from rainfall is inadequate for agriculture, or where, not much headway has been made to utilise the ground water sources - like the Nowgong district, dry farming practices should be adopted to make the best use of the little moisture that is available in the sub-soil. This requires a close understanding of soil and moisture conservation techniques, and their effective application in the fields. Further, the farmers should be conversant with rational utilisation of all resources available at their disposal. As an illustration, it may be pointed out that after harvesting the kharif crops, the land should be properly tilled so that the water from any succeeding rainfall
is retained in the soil. To prevent the limited moisture in the soil from being evaporated, it is necessary to cover the soil with a layer of straw, twigs, dust mulch, or banana leaves. Under dry farming method, crops which are quick maturing, capable of thriving on little moisture, insect, pest and disease resistant should be grown. Evidently, crops like rapeseed and mustard, sesamum, gram pulses, tur, maize, wheat, potatoes etc are expected to do well under dry farming conditions. It is advisable that arrangement of supply of seeds to the farmers, may be made through marketing agencies. Further, as extra-ordinary incentive, exemption of taxes, transport subsidy and revenue exemptions to the promising farmers may be provided. This will perhaps, encourage the farmers to grow crops even during the times of natural calamities or other exigencies.

CROP PROTECTION:

The hot and humid climate of the Brahmaputra valley encourages different kinds of air, soil and seed borne diseases to affect crops. Blast disease is common in 'ahu' and brown spot in 'sali' paddy. Sugarcane, jute, tobacco and rabi crops like oilseeds, pulses, maize, wheat, potatoes etc also are not spared. Among the common pests, mention may be made of 'stem borer', 'gundhy bug', and 'gall midge' which attack the early 'ahu' and 'boro' paddy crops. 'Sali' paddy is afflicted by 'leaf roller', 'hispa' and 'swarming caterpillars'. 
Due to lack of any consciousness on the part of the farmers about plant protection measures, the spraying of insecticides, pesticides etc to save crops from being destroyed, has not been adequate. Another reason for this state of affairs could be due to non-availability of plant protection chemicals and equipments in time. The farmers are also ignorant about the use of plant protection chemicals, specially, with regards to the methods and time of application and the quantity to be applied. Even then, suitable crop husbandry practices like removal of debris (unwanted materials), polluted water and weeds from the fields will supplement the efforts made by the farmers to check standing crops from being destroyed.8 Suitable crop rotations and mixed cropping systems also helps to reduce the effects of plant diseases and insects. The importance of proper field management and plant husbandry techniques is felt by all farmers, but, more specially by those adopting the high-yielding varieties of crops. To offset the threat to high-yielding varieties of crops, large quantity of plant protection materials should be made available to the farmers.9 Otherwise, the diffusion of hybrid varieties would be impeded, and agricultural transformation operations as such, may not be meaningful and substantial. An early surveillance system to locate attacks of pests and diseases is also felt very

8. These may also be called field management practices.

9. Plant protection materials are a vital input, next only to irrigation, in the spatial extension of the area under high-yielding varieties. Systematic plant protection measures are essential to obtain higher yields of crops as well.
desirable. Admittedly then, the establishment of laboratories under decentralised field investigation programme would be an effective means for detection and control of plant diseases, pests etc, and also nutritional treatment for higher production of crops. Proper enclosure of fields is also necessary to save standing crops from being damaged by animals.

**INFRASTRUCTURE REQUIREMENTS:**

Having considered the issues of fertiliser consumption, irrigation development, adoption of plant protection measures and scientific land and water management practices, the imperatives of building up sound infrastructural facilities needs proper assessment. This is necessary to foster agricultural development in the valley and for improving the socio-economic conditions vis-a-vis welfare of the rural masses.

Our experience indicates that the post harvest technology needs prime consideration. In fact, the provisions for storing agricultural commodities in the villages are far from scientific and adequate. Of course, most of the farmers have their own godowns for storing foodgrains, mainly paddy. These are locally known as 'Bhoral'. They are defective, for they are not properly ventilated and are prone to the circumstance of weather conditions, pests, rodents

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10. A 'Bhoral' is a small hut made of bamboo, wood, thatched grass, or tin, and are raised slightly above the ground.
and insects. It is pathetic to note that the farmers are either ignorant, helpless or careless about the necessity of scientific treatment of seeds/grains and their proper storage. Very often, the grains of paddy and wheat, for example, are brought from the fields, and before being sufficiently dry are stored in impoverished godowns. The result is that there is subsequent decay and loss of foodgrains. Ironically, most of the farmers in the valley save some grains from the better plants, to be used as seed in the subsequent year. Concurrently, the farmers rely very sparingly on seeds brought from the government seed farms like the Assam Seeds Corporation. Curiously enough, the farmers are eager to obtain seeds from their neighbouring farmers. This is due to the fact that the seeds obtained from the government seed farms were not tested for germination, quality, impurities or even variety. This partly explains the farmers' adamancy to obtain seeds from government owned seed farms.

To remedy these shortcomings, the number of rural warehouses needs to be increased in sufficient numbers. Such warehouses should preferably, be set up in a central village of a cluster of villages, so as to provide the storage

11. The functioning of the Assam Seeds Corporation has also received a serious setback due to considerable slackness on the part of the State Agriculture Department, incompetence of the workers of the seed corporation farms, absence of input supplies like implements, fertilisers, insecticides and infrastructure facilities like irrigation. The programme of producing quality seeds, has therefore, received lukewarm attention.
benefits to a rational number of agricultural population. If each rural warehouse is expected to cater to the needs of 500-600 agricultural population, then the villages have to be suitably clustered in the allotment of one such warehouse. Obviously then, in Goalpara a cluster of 4 villages should be allotted one warehouse. In Kamrup and Nowgong, there should be one warehouse between 3 villages; in Darrang one in 5 villages, and in the remaining three districts viz. Sibsagar, Lakhimpur and Dibrugarh there should be one warehouse among 9 villages. Appendix-X shows the approximate number of warehouses required in each district.

These rural warehouses should have scientific storage facilities, in the sense that they should be moisture proof, rodent proof and properly ventilated. Adequate cold storage facilities is also considered essential to store perishable agricultural commodities. Admittedly, due to poor storage facilities, the farmers' in the valley are compelled to sell their produce at unremunerative prices. It is further desirable to ensure, that foodgrains and seeds losses are curtailed to the minimum. Farm level storage facilities should take into account the accessibility pattern of the villages with the urban market centres. This is desirable to streamline the flow of foodgrains from the producing areas to the consumer markets. Furthermore, storage facilities should be built for storing agricultural inputs like fertilisers, insecticides, seeds and implements.
The storage facilities should take into consideration the spatio-temporal variations in agricultural production, demand for agricultural inputs and distribution needs. As public storage is unlikely to face the challenge, private storage facilities may supplement the efforts of the government. For rapid improvement, private sectors may perhaps be encouraged.

The problem of inadequate storage facilities is not the only one confronting the farmers of the valley. Even the marketing system in the valley is far from developed. A field study in Nowgong district reveals that about 25 per cent of the total annual production of paddy finds its way to the market. The marketable surplus came from small, medium and large farms. In the case of mustard and jute also, a large part of the produce is marketed (Chapter-6 Agricultural Marketing). Bulk of the transactions take place through middlemen agents or traders in the village itself. Unfortunately, the producers are denied remunerative and legitimate prices for their commodities and the middlemen traders corner bulk of the profits. The instrument of government procurement agencies like the Assam State Consumers' and Marketing Federation (S.T.A.T.F.E.D.) and the Food Corporation of India (F.C.I.) have not been effective in carrying out their procurement assignments, particularly in remote areas. The private traders, have therefore, made dent into the procurement arena. It has generally been the
experience that government administered procurement prices are not strictly adhered to by the farmers. An important contributory factor for this undesirable situation is due to the absence of a suitable market intelligence network. Quite often the poor farmers', have to make distress sales, much to their economic disadvantage. It is desirable that the exploitation of the poor farmers be halted fortwith. This can be conveniently done, provided the State Government fixes the 'floor' price for the agricultural commodities and takes necessary corrective measures to ensure remunerative prices to the farmers.

Another sector which needs serious consideration is the development of adequate all weather transport and communication facilities. More appropriately, it implies connecting the villages with the urban market centres and the urban centres with one another. It may also be added that the transportation sector affects agriculture directly, and, this is inextricably bound up with the overall socio-development of the valley. Though, investments in the transportation sector is not directly productive, yet, such investments should be evaluated against pressing agricultural needs. 12 Further, there should be proper coordination among different means of transport, which is

12. Included under the needs are movement of agricultural commodities from the farms to the urban market centres, and transportation of agricultural inputs from the towns to the villages.
so essential to streamline the movement of agricultural commodities and essential inputs. The deficiencies in respect of transportation facilities in the valley (Chapter-3) should be adequately integrated in any framework of agricultural planning and development. Appraisal and implementation of such a policy can best be started from the block level. It is observed that the farmers in the Brahmaputra valley are reluctant to produce more sugarcane. This is not due to lack of demand for sugarcane in the sugar mill, or khandsari units, but, more due to transport bottlenecks. Inevitably then, it is emphasised here that the farmers responsibility to raise agricultural production should be corroborated with the development of accessibility pattern.

Besides, the slow pace of rural electrification in the Brahmaputra valley, also casts its aspiration on the agricultural sector in particular, and the overall economy in general. Upto 1977, only about 9.57 per cent of the total inhabited villages of the valley have been covered by electricity. There exists considerable disparities in the electrification pattern among the districts (Chapter-3). On the whole, the issue relating to the slow pace of rural electrification include inadequacy of power supply, poor

13. The time lag involved in the movement of the sugarcanes from the fields to the factories, results in drying up of the sucrose content of the canes. Consequently, the recovery of sugar from dried canes will be less, and the farmers will not obtain remunerative prices for their produces from the mill authorities.
demand for power in the rural areas, shortages of construction materials and equipments, difficulties of laying overhead transmission lines, especially in the monsoon season, and flood affected areas as such. It is recommended here that the pace of rural electrification has to be accelerated to transform the basic agricultural cum agro-industrial economy of the valley. Power should be made available to the rural consumers, industries and commercial establishments etc so that the farmers are benefited directly.

Extending the benefits of power availability to the rural areas will help the farmers to energise pumpsets. These could be utilised to pump water from the underground sources for supplying it to the fields. The availability of sufficient electric power in rural areas will encourage entrepreneurs in setting up agro-based complexes in the urban, semi-urban and rural areas. Against this backdrop, the development of rice mills, flour mills, oil mills, sugar mills, jute mills, fruit and vegetable canning units, preparation of tinned foods like wheat malt and macaroni, based on locally available raw materials, should gain proper attention in the sphere of rural industrialisation of the valley. This will also encourage the growth of service centres for farm machineries.

14. In areas where hydro-electricity cannot be provided by overhead transmission lines, diesel oil should be made available to the farmers to operate pumpsets.
Additionally, the surplus rural labour force who are either seasonally or perennially unemployed will get employment in the agro-industrial complexes. More importantly, the extended use of electricity and irrigation will motivate the farmers to adopt a more compound cropping pattern, including the use of hybrid varieties. Intensification of cropping will raise the demand for various agricultural inputs. And, with the general improvement of the accessibility pattern, the movement of inputs and outputs to and from the farms and urban markets will become smooth and regular. This two-way linkage will stimulate the development of the agri-business sector to a large extent. The evolution of such combination will reasonably support the commercialisation of agriculture in the farm enterprises.

The problem here is how to make the essential agricultural inputs easily available to the farmers. In the valley, cooperative endeavours have met with partial success. Nevertheless, the organisation of the farmers into a corporate body on the lines of the Farmer's Service Societies (F.S.S.), may help such societies to arrange the supply of agricultural inputs like good seeds, fertilisers, insecticides, pesticides, implements etc to the farmers' at nominal rates, or on hire basis. The F.S.S. should be constituted in each Block of the valley. It should have trained personnel to provide necessary guidance to the farmers'
on modern and scientific methods of farming. It will also function as an extension agency, and will supplement the efforts of the State's Agriculture Department. Though the F.S.S. is to be an autonomous body, it should work in close unison with the State's Agriculture, Revenue, Irrigation and Cooperative Departments, and should have adequate liaison with the Assam Agricultural University at Jorhat, and the zonal centres of the Indian Council of Agricultural Research (I.C.A.R.).

Conceptually, it can be envisaged that, agricultural stagnation in the Brahmaputra valley is a situation where land capability has not been fully utilised due to input constraints, inadequate incentives, poor economic conditions and insufficient technical knowledge of the farmers. Also, inadequate number of demonstration units, the marginal impact of the Extension agencies on the farmers outlook, and considerable slackness on the part of the farmers to innovate new farming techniques has resulted in the present state of affairs in the agricultural scenario of the valley.

It is by now known that, most of the farmers in the valley are poor, and are by and large indebted to some private money lenders and sometimes with some financial

15. The personnel of the F.S.S. should also be trained in repairing agricultural equipments and machineries. The Block level F.S.S. should assist the State Government to formulate agricultural policies pertaining to agriculture and rural development in the block level. That means the State Government's schemes on agricultural development will be routed through the Farmer's Service Societies.

16. The liaison is essential to transfer the fruits of new research findings from the laboratories/research institutions to the fields.
institutions. To free them from the clutches of money lenders in future, there must be a numerical increase and spatial expansion of financial institutions in the rural areas. This is essential in order to make the availability of credit to the farmers easy, and to contain the unscrupulous activities of the private money lenders. More importantly, loans should be advanced to the small and marginal farmers, tenants (including share croppers), landless labourers and village artisans on easy terms and less cumbersome conditions. Evidently, reliance on non-institutional finance will be inadequate, and is not likely to contribute to the socio-economic upliftment of the valley's population.

Admittedly, a healthy promotion of infrastructural facilities will stimulate the growth rate of agriculture, and accelerate the healthy development of the agri-business sectors as well. There would also be a concurrent increase of non-agricultural activities in the rural areas. The integrated concept of agricultural development embracing proper and full utilisation of available resources, market planning, provisions for input supplies, extending the benefits of credit supply from financial institutions, generation of industrial and commercial activities and other services will have the propensity to generate sufficient

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17. The financial institutions encompass Land Mortgage Banks, Nationalised Banks, State Cooperative Bank and Regional Rural Banks.
growth impulses in the rural areas of the valley. It will altogether lead to the orderly growth of economic activities based on a broad platform of agricultural development. This is likely to solve the burning problems of income and employment of the population living in the rural areas. The spread effects of such a development will ultimately percolate to all corners of the rural areas. This will provide a linkage between the rural areas and the wider market economy. Such a process will make the rural people active participants in the valley's all round socio-economic progress.

Simultaneously, the orderly growth of new towns based on agriculturalization will be an effective tool to check continuous influx of people from the villages to the existing urban centres. Agricultural development, if explicitly designed on the principles of planning and management, will be an effective tool, for promoting balanced regional development of the Brahmaputra valley.

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18. The new towns should also have different services like education, health, recreation, banking, markets, and so on to meet the requirements of the population in these towns, as also, of the hinterland villages.