

# **Agricultural Production Technology And Status Of Foodgrain Production In Bangladesh.**

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## **Introduction :**

Bangladesh is a food deficit country in terms of total annual domestic production of major cereals i.e. rice and wheat their availability for consumption and total annual requirements of these foodgrains. However, the equation of food balance does not recognise the magnitude of domestic production of other components of human food namely, vegetables, fruits, pulses, etc. and not to talk about animal sources of human food.

In the socio-political and cultural context of Bangladesh, foodgrain self-sufficiency in terms of production of rice and wheat is more important at least at the present time for which government policies relating to the country's agricultural vis-a-vis economic development centre around increased domestic production of rice and wheat to be able to meet its total annual requirement. The concept of self-sufficiency in this context implies that the requirements for human consumption and for seed and feed should be met from the production within the country.

Self-sufficiency objective for foodgrain production as a national policy for this part of the world now known as Bangladesh was announced in 1960s. The then Governor of East Pakistan announced, "We must do everything within our resources to boost up agricultural production so that not only we attain self-sufficiency in food but are also in a position to export and earn valuable foreign exchange ..... This, however, is to be done only if we succeed in awakening the vast majority of our people who still hold on to the ancient methods of cultivation..... these are the people who must be made conscious of better yield through the use of scientific methods. " (Government of East Pakistan, 1967).

The national development goal remains to be achieving self-sufficiency in foodgrain production and even today after two decades of the first announcement

of self-sufficiency objective the country production is still far behind the targets. This does not mean that there has not been any development in term of **foodgrain** production. Certainly, there has been significant increase in production of both rice and wheat in Bangladesh, but this has been not enough to attain the level of self-sufficiency nor the **foodgrain** production level ever reached its planned targets. Agricultural planning and development pursuits **demonstrated** a **miserable** failure in this context.

It appears that the political will, policy guidance, planning objectives and implementation strategies of development programmes are not going hand in hand. It has been noticed that there has been a tendency of **hurridly** preparing plans, setting targets without much objective analysis but then frequently changing plans, altering targets and shifting the timeframe, A big gap can be seen between thinking and doing by technical experts, planners and **administrators**, the policy makers and politicians. Technical **experts/** scientists do not have enough courage to communicate facts and reality with the planners and administrators. Planners appear to be hesitate in making realistic plans and appear to be influenced and biased with whims and unrealistic aspirations. Administrators appear to be not conscious enough to give the policy makers and politicians appropriate guidance and inputs for making realistic and achievable policies. The policies are therefore not appeared to be transformed into implementable programmes. This dimension of lack of proper interaction amongst the players of development games referred above should be analysed for identifying the gap mentioned above and for making achievable plans and programmes centred around sound policies and realistic aspirations.

### **National Development Plans and Food Production :**

The central objective of the First Five Year Plan (1973-78), Two Year Plan (1978-80), Second Five Year Plan (1980-85) and the Third Five Year Plan (1985-90) has been the attainment of food self-sufficiency. During the Second Five Year Plan period, a very specific programme named Mid Term Food Production Programme (MTFPP) was adopted to attain self-sufficiency in food production by 1985 without however, much success. Planning was perhaps unrealistic **and/or** strategies adopted were perhaps inappropriate, **and/or** management of agricultural development programmes was perhaps inefficient. In real sense agricultural policy was not well **defined** and specific. **Neither** such policies were adequately integrated to and consistent **with** other development policies and programmes. This resulted in not bringing about the desired breakthrough in agriculture in general and for food production in particular.

Agricultural development planning in Bangladesh has always been concerned with the crisis management of short term nature and so there was no attempt in policy shift towards long term development of science based **modern** agriculture. It was not therefore possible to make a permanent shift in the agricultural productivity for foodgrain production. The agriculture in Bangladesh therefore always remains under constant **threat** of food shortage and fear of famine.

### Targets and Achievements in Foodgrain Production :

The **foodgrain** production target under the First Five Year Plan (1973-78) was 15.44 million tons in 1977-78. The actual production was, however, only 13.10 million tons leaving a gap of 2.34 million tons. In view of this failure the Second Five Year Plan (1980-85) included the special programme mentioned earlier called MTFPP with the target production of 20.0 million tons in 1984-85 with the following strategies:

1. A 100% increase in the irrigation levels in the country from 3.6 million acres to 7.2 million acres.
2. Increased use of HYV seed from 6000 tons to 58,000 tons.
3. Improvement of 2 million acres by drainage and flood control measures for Aman and Aus i.e. about 20% of the area cropped in these seasons.
4. Increased fertiliser use by 126% from 840,000 tons during 1979 to 1.9 million tons by 1985.

The target of **foodgrain** production being over ambitious and unrealistic it was subsequently revised downward and a lower production target of 17.5 million tons was aimed at for 1984 - 85. The achieved production on 1984-85 was 15.83 tons as shown in Table-1.

The Third Five Year Plan document does not indicate any year-wise **foodgrain** production targets. However, Ministry of Agriculture on ad-hoc basis decides on yearly production targets. For the first two years of the Third Five Year Plan period i.e. for 1985-86 and 1986-87 production targets and actual production of foodgrains are shown in Table-2. Each year actual production fell **short** of the targets. It has been estimated that over 16 percent more production was required to meet the total annual requirements for 1985-86 and 1986-87 over the actual production (Table-2).

### Technology in Use and Production of Foodgrains :

There have been various estimates of growth of **foodgrain** production in Bangladesh. In 1975 it was estimated that during the period 1960-61 and 1974-75, the average annual growth of foodgrain production was 1.1 percent. However, since the introduction of the high yielding rice varieties in mid 1960s, the growth rate was 2.1 percent per annum upto 1974-75 ( Islam and Ahsan, 1978). another series of estimates reveal that for the decade of 1960-70, the average foodgrain production growth rate was 2.45 percent while for the decade of 1970-80 it was 2.67 percent and that for the decade of 1980-87 was 2.2 percent (Ahsan, 1987).

All these estimates were for both rice and wheat. Another estimate reveals of 3.4 percent growth of **foodgrains** in Bangladesh since 1971 (Hossain, 1988).

There is no doubt that this increase in foodgrain production has been **associated** with adoption of improved technology in the form of fertilizer, irrigation and new rice varieties evolved at International Rice Research Institute, Bangladesh Rice Research Institute and similar rice research centres in other countries. The real breakthrough in rice production technology for higher yield came with the IR - 8 rice variety which is responsive to higher soil fertility under irrigated condition. Its dwarf **characteristics** with short straw enables it to prevent lodging under heavy fertilizer application.

These high yielding rice varieties in Bangladesh have been spread less rapidly than many other rice growing countries in Asia. Till 1986-87 these varieties had spread to about one-third of the total rice land in Bangladesh (Bangladesh Bureau of Statistics, 1988) while in Pakistan the adoption of these new rice varieties reached over 50 percent of her rice area in 1971-72. Sri Lanka grew these rice varieties in **over 70 percent of her** rice area in 1977-78.

In the Philippines, the adoption rate of these rice varieties was also over **70%** in 1978-79 and in Indonesia it was **60%** in 1979-80. India attained the adoption rate of these rice varieties in about 50% of her **total** rice land in 1979-80 (IRRI, 1982).

The concept of improved agricultural technology particularly for rice production is not new to the farmers of Bangladesh. Use of chemical fertilizers among Bangladeshi farmers started in late 1950s and was fairly established by the mid 1960s. However, the product mix of fertilizers was different then from what are being used now. Ammonium Sulphate was the major item together with Super Phosphate and Muriate of **Potash**. Urea is **mostly** used now in place of Ammonium Sulphate and Super Phosphate has been replaced by Tripple Super Phosphate and other phosphatic **fertilizer**. The total consumption of fertilizers reached as high as 1-32 million tons in 1986-87 (BBS, 1989). However, fertilizer use on a per hectare basis is still low in Bangladesh. Besides fertilizer use efficiency in Bangladesh agriculture is also quite low. Studies revealed that hardly 30% of nitrogen used in rice cultivation is utilized by **plants**. The rest is either lost out of soil or not available to the rice plant.

The usefulness of irrigation for **agricultural** production **increase** is also not new knowledge to the **Bangladesh** farmers. **Traditional** system of irrigation has been in practice in Bangladesh for long time. Mechanized imigation with the use of pumps and **tubewells** was introduced here over 20 years ago. To date about 20 percent of **the** net cultivated area in Bangladesh is under irrigation (MPO Tech. Paper 14, 1986). These **irrigated** lands are mostly cultivated in the winter season with high yielding rice varieties and with use of fertilizers.

Successful expansion of irrigated agriculture with appropriate **water** management and flood control is **the** hope for application of **improved** production

technology with high yielding varieties and application of fertilizers and thereby increase foodgrain production.

Mentioned earlier that 100% expansion in the irrigation area was proposed as the most significant element of the MTFPP **strategy** for increase in foodgrain production through, (i) increase in crop area and (ii) increase in yields by expanding use of high yielding varieties and fertilizers. Elasticity estimates of crop yields with respect to the use of irrigation and high yielding varieties and fertilizers as well as fertilizer demand elasticity estimates with respect to the use of irrigation and high yielding varieties revealed that the irrigation policy for the proposed expansion of irrigated area by itself was not sufficient to obtain the level of foodgrain production to achieve the production target by 1985 (Table-3). The study also revealed that the stated irrigation policy was not sufficient to expand use of fertilizers needed to achieve the fertilizer consumption target (Sidhu, Baanate & Ahsan, 1982).

Improved variety is the key element of the improved agricultural production technology popularly known as 'Green Revolution'. Although the new varieties of rice and wheat known as high yielding varieties have been evolved in mid-1960s. but the concept of better varieties and their contribution to the yield increase was also known to the Bangladeshi Farmer for long time back. The varieties used to be known as improved varieties are now called Local Improved Varieties (LIV). Rice production technology practiced by farmers in terms of use of varieties demonstrated farmers knowledge and perception about the particular varieties and their suitability to the specific agro-climatic characteristics as well as soil and hydrological conditions of the rice lands. Farmers therefore used to grow various combination of improved varieties and other environment specific varieties to fit into the local environment in terms of land topography, hydrological conditions and flood water depth etc. The Indian Council of Agricultural Research reports of existence of about 40,000 rice varieties in India (ICAR, 1976). Many of them are also known and grown in Bangladesh.

Mentioned earlier the improved technology with the modern varieties (IR8 type of rice and Maxican hybride type for wheat), irrigation and fertilizer made positive contribution to increase in foodgrain production in Bangladesh. However, as adoption of these varieties has been slow and incomplete, the impact has not been very significant as desired particularly in terms of attaining foodgrain self-sufficiency.

A glance through the rice production statistics over several years reveals that adoption of the modern high yielding rice varieties has been widespread in boro season (winter) which was as high as 89% in 1986-87. However, in other two rice growing seasons namely, aus and aman the adoption rates are about 20% and less (Table-4). Growth in the adoption of HYVs in boro season was under irrigation. This is also the season when Maxican hybride type wheat mainly Sonalika variety was largely adopted and made significant contribution to the increase in total foodgrain production in Bangladesh. There has been substitution effect of areas

under cultivation of HYV rice (**boro**) and HYV wheat depending upon the comparative advantage to the farmers in utilizing irrigation facilities. The slow rate of adoption of improved technology with new high yielding rice varieties among Bangladeshi farmers was because the available technology does not fit well into the local conditions and is unable to overcome the local barriers (Ahsan & Haque, 1977). Although the variety component (HYV) of the improved technology is neutral to scale *i.e.* it does not discriminate among different farm sizes but the resource poor farmers find it difficult to have adequate access to irrigation and needed credit to purchase important input like fertilizers. Also the inputs **distribution** and marketing operations are not performing well which appears to be a constraint to the farmers in adopting the improved technology (Ahsan, 1976). Because all necessary component technologies are not accessible to the farmers either because of their resource **constrains** or because of other barriers the technology available to the Bangladeshi farmers and adopted by them are in real sense not the complete package of the technology.

The modern rice varieties are profitable but their adoption has had relatively less impact on average yield of rice. This is because of incomplete adoption of technology and lack of coordination in inputs use. Also there is wide seasonal variations in growing rice in Bangladesh and the modern rice varieties are not well adaptable to all the seasons because of environment and land-hydrological characteristics. Among the thousands of traditional rice varieties used to be grown and now grown by the Bangladeshi farmers there are varieties suited to and grown under a very wide range of natural conditions: in saline and acid soils, in slopes and high altitudes, and in different depths of water. About 20% of total rice area in Bangladesh is low land areas. These new rice varieties (**HYVs**) can not be grown there because of deep flooded condition.

### **Yield Gap Concept**

Appropriateness and adaptability of technologies are also assessed by yield gap analysis. The concept of yield gap refers to identification of different levels of productivities of rice farms. These are, (i) average farm level productivity being achieved by farmers, (ii) highest level of productivity to measure the highest potential production level by application high technology under experimental condition and by application of optimum practices, and (iii) economically attainable level of productivity which is achievable under **farmers field** condition by successful application of the improved technology. Figure - 1 explains the concept of the different yield levels and the gaps.

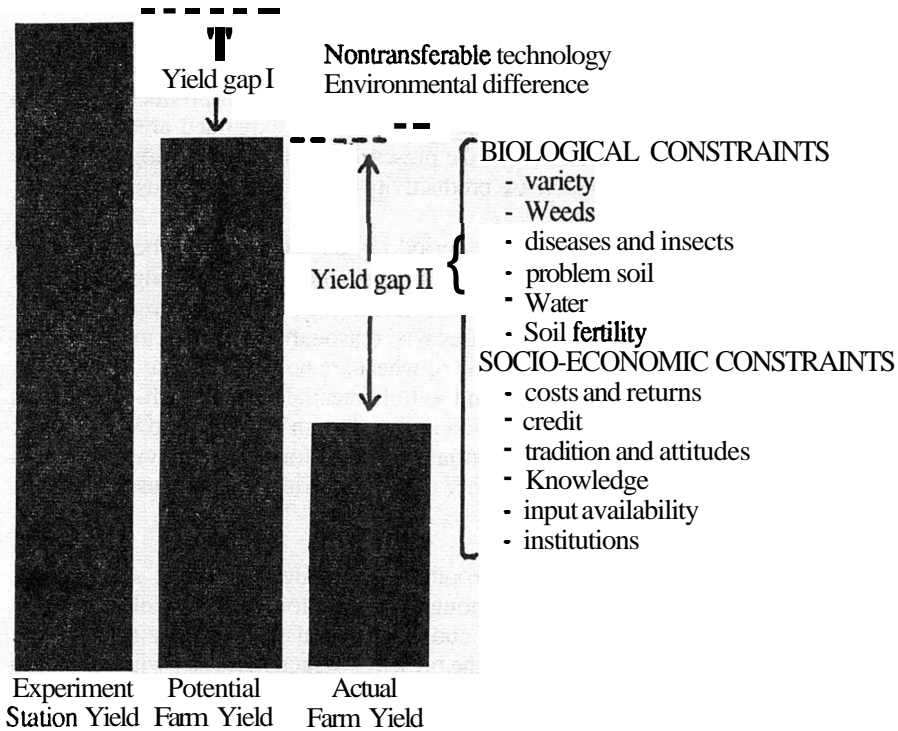


Figure 1. Yield Gap Concept ; and Constraints to Higher Yield.

In this context **Yield Gap-1** indicates the difference between the highest yield and economically attainable yield, and the **Yield Gap-2** indicates the difference between the economically attainable yield and farmer average yield level. The contributing factors to this **Yield Gap-2** are both technical and socioeconomic. The socio-economic factors include farmers resources constraint (credit need), non-availability of inputs, land tenure system, social structure, risk element etc. Appropriateness of the technology and successful adoption of the same is expressed by the size of **Yield Gap-2**. Larger the size of this gap **greater** is the opportunity for production increase by spread of technology adoption at farm level. The size of **Yield Gap-1** implies that the physical and environmental conditions available are not suitable for this technology for being adapted at the farmers levels. This implies that either physical characteristics and environment are to be modified or different technology is to be evolved particularly in respect of plant type to fit into such local environment and physical characteristics.

yield Gap-2 can be reduced by marginal modification of the component technologies and management practices as well as through appropriate policy measures. This is the desirable route to increase **foodgrain** production in **short run**. A farm level study in Bangladesh reveals that **Yield Gap-2** during boro season

ranged from 0.4 to 4.1 tons per hectare while this gap for aus season was quite low ranging from 0.1 to 0.5 tons per hectare (Ahsan and Haque, 1977). This implies that there exists greater scope for further increase in **foodgrain** production in boro season if available improved technology is adopted in expanded areas **i.e.** with expansion of irrigation facilities while the presently available technology is unable to contribute significantly to increase productivity of rice farmers in aus season.

Wheat is grown in one particular period **i.e.** during winter. Wheat **varieties** being basically imported crop and its **introduction** to the farmers in Bangladesh was associated with the package of improved technology including high yielding varieties, adoption of these new varieties was reasonably high. Socio-economic factors influencing successful cultivation of wheat are however similar to those for cultivation of rice at the farmers level and so full potential of wheat cultivation is yet to be achieved. Besides, wheat cultivation in Bangladesh is confronted with serious challenge of non-availability of appropriate varieties for tropical environment as well as for the danger of high dependence on **single** variety which **caused havoc** in many other countries in the past.

Appropriate wheat variety for tropical **environment** which is suitable for Bangladesh is not yet available. Although introduction of high yielding wheat variety was initially quite a success and contributed significantly to the total **foodgrains** production in Bangladesh, the present productivity **trend** with respect to wheat is not very encouraging. This has resulted from both decrease in area under cultivation **as** well as in **terms** of lower production per unit of land area.

### **Agricultural Technology and Future.**

An attempt has been made in the earlier discussion to convey that the present available so-called improved technology for agricultural production increase did not have widespread adoption at the farm level. However, to the extent the component of improved technology like HYV seeds, irrigation and fertilizer were adopted by the farmers partially or wholly in limited scale and **recognising** the fact that application of irrigation facilities and fertilizers were not that efficient, the impact of HYV irrigation fertilizer **technology** can be recognised by its contribution to the **foodgrain** production level in the country. High yielding rice varieties were grown in about 30% of the total rice area which however, contributed to nearly 43% of total rice production in the **country** in 1986-87. Considering the contribution of HYV **wheat** the seed **based** agricultural technology could contribute to about half of the **total foodgrain** production in Bangladesh in 1986-87 (Table-4).

However, scope for further expansion of these technology components (variety-irrigation-Fertilizer) in **extremely** limited with the available rice and wheat varieties under **the** existing soil hydrological characteristics. Further extension of the high yielding varieties and fertilizers is possible only with the successful expansion of irrigation facilities in certain seasons and assured flood control and drainage **measures** which is not likely to happen soon in the very near **future**. To some extent with adoption of realistic policies including pricing and **distribution** and



efficient implementation of some programmes like credit programmes, irrigation management etc. the present improved technology is likely to spread further. However, historical experience on transformation of policies into implementable programmes and management aspects of the agricultural development programmes tends to imply the attempt of policy intervention for rapid spread of technology adoption at the farmer level is not likely to be an easy success.

Recognising the fact that agricultural production increase through horizontal expansion of cultivation is not possible increased foodgrains production in Bangladesh must come from **vertical** intensification of production system. This implies that government policy for **foodgrain** self-sufficiency must be transformed into strategies and programmes for continuing efforts of technological innovation developed and adoptable to the numerous micro-environments within the farming communities of the **country**. The approach for future should therefore also **recognise** the need for changes in the characteristics of the technology itself. This implies development of different plant types to fit into the local environments where the presently available plant types cannot grow, development of technology for moisture stress and problem soil conditions and measures for **expediting** speed and **rate** of technology generation.

### **Environment and Technology.**

Mentioned earlier, among thousands of the traditional rice varieties, one or the other grows over an extraordinarily wide range of environment climatic and edaphic. Such adaptability of varieties to a particular environment and season has been a tremendous benefit to the cultivation of rice. It should however, be clear that there are two types of adaptability. One is the adaptability of environment specific varieties and the other refers to the adaptability of a single variety to a wide range of environments. The concept of breeding strategy for development of varieties adaptable to a wide range of environments needs to be reconsidered now in favour of environment specific varietal development strategy.

The most significant environmental issue with respect to rice cultivation in Bangladesh refers to the improvement of rice production in high and medium rainfall areas in monsoon season. The areas include the deltas and other low-lying land which becomes water logged or flooded in the monsoon.

Non-availability of appropriate varieties caused a perpetual uncertainty in rice cultivation both in aus and **aman** seasons. Most of these lowland rice areas are double cropped areas where aus rice (either broadcast or transplant) is followed by transplanted **aman** rice. If due to either early drought or flood the first crop is delayed the cultivation of the second rice crop i.e. transplanted aman is also delayed subsequently. In such delayed condition the existing modern varieties are not very suitable because most of these new rice varieties are not photoperiod sensitive and are not good for late planting. Also these modern varieties are not adaptable to water depth prevailing in these lands. Appropriate varietal characteristics for these

lands include drought resistance, submergence tolerance, and photoperiod sensitivity (Ahsan, 1987).

The challenge with the rich scientists for the future are developing high yielding technology by evolving varieties with high yield potential and technology for different growing conditions, ranging from moisture stress for dry land farming in upland condition to moisture excess or flooded deep water conditions. The future technology should also aim to increasing production capacity of adverse soils with salinity, alkalinity, acidity and various kinds of soil toxicity. It may be noted that widespread cultivation of one type of varieties poses a danger of reduced genetic diversity at the farm level. Such genetic diversity should be maintained or these varieties otherwise suitable for sub-optimum conditions will be extinct and the genetic base for future research will be narrowed down. Above all the new technology for high yielding capacity should be less capital intensive with low risk for being adopted by resource poor small farmers who are majority in the farming community in Bangladesh.

Agricultural research programmes in Bangladesh should have focus on local problems and address the issues on agricultural dependence on weather. Strategies for development of short duration rice and wheat crops, taller plant height and photoperiod sensitivity for rice and adaptable to warm days for wheat should receive research priorities. Research programmes should also address appropriate agricultural diversification strategies. The conventional breeding programmes should be supplemented by bio-technology techniques to speed up the process of development of new crop varieties with grain yield stability. Tissue culture technique has already demonstrated promising results for development of varieties with tolerance to moisture stress, soil problems and diseases.

The challenge of continuing changes and development of appropriate technology includes both evolving different plant types as well as other innovations relating to management practices to improve water and fertilizer use efficiencies and pest management as well as post harvest technologies to reduce post harvest loss of foodgrains. However, the necessary pre-requisites for success in such continuous research efforts is full commitments of the investors of agricultural research, may be the government and other agencies like international donors promoting agricultural research and development.

Unfortunately, the environment for investment in agricultural research in Bangladesh is not that favourable. Agricultural research is wholly dependent on government funding and the level of such funding has been far below the minimum requirement level. Although in the government documents statements on need for research find place but in term of allocation of resources research has a very low profile.

A study on resource allocation for agricultural research reveals that agricultural research in Bangladesh suffers from lack of adequate funding for operations of research. There was a 36% shortfall in operational fund for research. There has

been some improvements in the recent times in the allocation for agricultural research and a positive trend if noticeable in the allocation for research as percentage of gross domestic product over time. But the level of allocation is still below the level of 0.7% of gross domestic product suggested in the National Agricultural Research Plan (Ahsan, 1981). Also it has been observed that allocation in agricultural research has not been consistent with net availability of funds as very frequently the Annual Development Programmes are **revised, mostly** downwards and cut in the original allocation in agricultural research has been a common phenomenon.

Besides the financial problem the agricultural research system also suffers from coordination and management problem. A coordinated and cohesive agricultural research system is the prerequisite for developing the capability of the system to meet the future challenge in developing appropriate technologies for development of agriculture. Unfortunately Agricultural Research Systems in Bangladesh is characterised by high degree of fragmentation in research efforts. Research programmes are carried out by a large number of institutes and centres being controlled by different ministries. The tendency of **institutes/centres** to work in isolation, proliferation of research efforts, lack of problem oriented programmes are counter to provide adequate research backing for agricultural development efforts. There have been some government attempts to consolidate agricultural research in Bangladesh through establishment of a central agricultural research coordinating agency, the Bangladesh Agricultural Research Council (BARC) but the efforts were not significant enough to enable BARC to perform its important functions of coordinating and consolidating agricultural research as desired by its charter. The list of agricultural research agencies in Bangladesh is given in Table-5.

### **Conclusion :**

An attempt has been made in this paper to convey that the problem of foodgrains production in Bangladesh are by no means solved even though high yielding technologies have been developed but adopted less widely by the farmers in Bangladesh. Contribution of the technology to the increased production of foodgrains is recognised but average agricultural productivity still remains low and the technology has not yet sufficiently overcome the local problems and natural environment. What has been focussed in this paper is the realisation of the need for much more environment specific research in all relevant fields. The future innovation of technology must recognise that varietal adaptation is both a local matter and a seasonal matter in Bangladesh context. In the pursuit of technology generation it must be remembered that the genetic diversity must be maintained or the genetic base for future research will be narrowed. Technology generation and their continuous changes to fit them in the more and more unfavourable conditions need full commitments of policy makers, planners and top administrators for allocation of resources in agricultural research and strengthening agricultural research system for management and coordination of agricultural research.

“Agriculture moves forward speedily only when an economical and culturally acceptable technological packages is supported by appropriate services and public policies. Technology becomes effective when the production system is viewed in totality.” (IRRI, 1982)

TABLE -1 : A Target and Actual Production of Foodgrains during Second Five Year Plan.

(Million long ton)			
Crop	SFYP target	Actual production 1984-85	Gap
Aus	3.89	2.74	(-) 1.50
Aman	8.35	7.93	(-) 0.55
Boro	3.40	3.85	(+) 0.45
Total Rice	15.64	14.39	(-) 1.25
Wheat	1.86	1.44	(-) 0.42
Total foodgrain	17.50	15.83 <sup>a/</sup>	(-) 1.67

Source : Third Five Year Plan (1985-1990).

a/ In terms of metric ton the actual production was 16.08 million tons.

TABLE-2 : Foodgrain Production Target of Third Five Year Plan, 1985-1990 and Actual Production of 1985-86 and 1986-87.

(million metric ton)						
Crop	TFYP Target and Actual Production					
	1985-86			1986-87		
	Target	Actual	Gap	Target	Actual	Gap
Aus	3.29	2.83	-0.46	3.21	3.13	-0.08
Aman	8.59	8.54	-0.05	8.50	8.27	-0.23
Boro	4.16	3.67	-0.49	4.20	4.01	-0.19
Total Rice	6.04	15.04	-1.00	15.91	15.41	-0.50
Wheat	1.60	1.03	-0.57	1.51	1.09	-0.42
Rice & Wheat	17.64	16.07	-1.57	17.41	16.50	-0.92
Coarse Cereal	NA	NA		NA	NA	

Source : Department of Agricultural Extension.

TABLE-3 : Crop Yield (Production) Elasticities with Respect to use of Irrigation, HYVs and Fertilizer, Bangladesh.

	Boro	Aus	Aman	Three Seasons <sup>a/</sup> Weighted Average
Production elasticities with respect to the use of ;				
Irrigation	--	0.018	--	0.005
High-Yielding Varieties	<b>0.352</b> <sup>b/</sup>	<b>0.087</b>	<b>0.047</b>	<b>0.145</b>
Fertilizer	0.117	0.300	0.038	0.071
Weight of area cropped	<b>0.280</b>	<b>0.300</b>	<b>0.420</b>	

a/ Weighted average obtained by using the sample distribution of the areas cropped by season.

b/ In the boro season the use of irrigation is highly correlated. Therefore, the elasticity estimate for HYVs probably show the joint effects of irrigation and HYVs.

Source : Sidhu, Baanante and Ahsan, 1982.

TABLE - 4 : Foodgrains Production In Bangladesh by Varieties, 1986-87.

(million tons)					
Crop	Local	HYV of total	Total	H. W as % of total	Rice as %
RICE					
Aus	2.163	0.965	3.128	30.9	18.967
Aman					
T. Aman	4.395	2.524	6.919	36.48	41.954
B. Aman	1.346	Nil	1/346	Nil	8.162
Boro	0.431	3.578	4.009	89.25	24.308
WHEAT	--	1.090	1.090	100.00	6.609
<b>Total</b>	<b>8.335</b>	<b>8.157</b>	<b>16.492</b>	<b>49.460</b>	<b>100.00</b>

Source : Bangladesh Bureau of Statistics.

**TABLE-5 : Name Of The Institutions Involved In Agricultural Research.**

	Name of the Institute	Ministry
1.	Bangladesh Agricultural Research Council.	Agriculture.
2.	Bangladesh Agricultural Research Institute	do
3.	Bangladesh Rice Research Institute	do
4.	Bangladesh Institute of Nuclear Agriculture	do
5.	Sugarcane Research and Training Institute	Industries
6.	Bangladesh Tea Research institute	Commerce
7.	Bangladesh Livestock Research Institute	Fisheries and Livestock
8.	Bangladesh Fisheries Research Institute	do
9.	Bangladesh Agricultural University	Education
10.	Dhaka University	do
11.	Rajshahi University	do
12.	Chittagong University	do
13.	Bangladesh University of Engineering and Technology	do
14.	Bangladesh Institute of Development Studies	Planning
15.	Bangladesh Academy for Rural Development	Rural Development and Local Government
16.	Rural Development Academy	do
17.	Bangladesh Council of Scientific and Industrial Research.	Industries.

**REFEREKCES**

- Ahsan. Ekramul 1976 "Farmers Choice and Decision-Making in Adoption of **Improved Rice Production Technology**", Proceeding of First Review Meeting of INPUTS Project, **Honolulu** : East West **Food Institute**, East West Centre.
- Ahsan, Ekramul and M. **Zahidul Haque**, 1977, "Bangladesh, **Aman** 1975, **Boro** 1975-76 and Aus 1976". Constraints to High Yields on Asian Rice Farms, **Los Banos International Rice Research Institute**.
- Ahsan, **Ekramul**, 1981, "Resource Allocation in Agricultural Research in Bangladesh. "Resource **Allocation** in Agricultural Research, **Ottawa** : International Development Research Centre.
- Ahsan, Ekramul 1987, "**Foodgrain** Production in Bangladesh : Impacts of Flood **1987**" Savar : Bangladesh Public Administration Training Centre (Merneo).
- B.B.S** 1989 Monthly Statistical Bulletin, October, 1989, Dhaka : Bangladesh Bureau of Statistics.
- Government of East Pakistan **1967**, Programme to Boost up Food Production in East Pakistan, Dhaka : East Pakistan Government Press.
- Hossain, Mahabub. 1985 "Fertilizer Consumption, Pricing and Foodgrain Production in Bangladesh", Dhaka : Bangladesh Institute of Development Studies, (**Memeo**).
- Hossain, Mahabub. 1988 "Nature and Impact of the Green Revolution in Bangladesh", IFPRI Abstract, Research Report 67, Washington D.C. International Food Policy Research Institute.
- ICAR, 1976 Research Highlights, 1976. New **Delhi** : Indian Council for Agricultural Research.
- IRRI, 1982 A Plan for **IRRI's** Third Decade, Los Banos : International Rice Research Institute.
- Islam. M. **Amirul** and Ekramul Ahsan, 1978 Population Food Imbalance and Food Self-sufficiency Strategy for Bangladesh for **2000 A.D.** Dhaka : Bangladesh Agricultural Research Council.
- MPO, **1986** "**Agricultural Production System**," Technical Report No. 14, Dhaka : **Master Plan Organization, Ministry of Irrigation, Water Development and Flood Control, Government of Bangladesh (Memeo)**.
- Sidhu, **S.**, Carlos Baananta and Ekramul Ahsan, 1982, Agricultural Production. Fertilizer use and Equity Considerations. Muscle Shoals: International Fertilizer Development **Centre**.