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Use of Modern Inputs in Nepalese Agriculture

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INTRODUCTION

The role of agriculture in promoting economic growth has been sufficiently underlined in Nepalese economic literature. But economic growth could be promoted if there is large enough increase in agricultural productivity. The agricultural productivity, in turn, depends on the behaviour of farmers and the environment in which they operate. The environment is composed of geo-climatic, socio-cultural and institutional factors. Thus, there are large number of factors which govern productivity on farms. Assuming that the farmers are rational, an improvement in the environment could help increase in agricultural productivity. But the geo-climatic and socio-cultural factors are not so malleable in the short run. Therefore, from agricultural policy perspective, the institutional factors are most pertinent in agrarian economies. The scope and coverage of institutional factors, however, differ from country to country and so do its reform measures, depending upon the interest of ruling elite and the prevailing agrarian structure and economic condition. Due to this fact, an unanimous definition of either land reform or institutional factors is lacking. Broadly, the institutional framework may be defined as the combination of infrastructure, superstructure and tenurial structure.

The tenurial structure is related to the distribution of land ownership and tenancy. Before the emergence of panchayati system in the country in 1961, some acts were formulated to improve the tenurial structure, but most of them remained black and white. They were heaped in dark room for insects to feed on. However, the government of Nepal had envisaged these measures as an instrument of social justice. After 1961, there was a marked change in official thinking regarding the scope of land reform policy. Land reform was considered to be of crucial importance in the successful implementation of the economic and political goals of panchayat system. Simultaneously, His Majesty's Government of Nepal realized that such steps as protection of tenancy rights, control of rents and interest rates, and imposition of ceiling on land holding should be supplemented by arrangements for the supply of credit, fertilizers and irrigation facilities and for the development of cooperatives.

Thus, the attention of the government has shifted from the land reform proper to land reform general or to agrarian reform. Then, Land Act 1964 was introduced all over the country in three phases during the period 1964 to 1966. It aimed at remoulding agrarian relations with a due creation of superstructure and mobilization of capital and surplus manpower

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from agriculture. This programme is regarded as the most comprehensive and scientific programme ever made in the history of agrarian reforms in Nepal.

With the introduction of Land Reform Act 1964, several attempts were set to improve the superstructure and infrastructure of the agricultural sector. For the provision of credit, Cooperative Bank was established which was converted into the Agricultural Development Bank in 1968. In 1967 Land Reform Saving Corporation was set up which was merged in Agricultural Development Bank in 1973 with a view to adopting a single credit agency approach. The third plan (1965-70) stressed the need for improved farm practices and increased use of modern inputs. Accordingly, Agricultural Supply Corporation was established instantaneously in 1966 which was later converted into Agricultural Marketing Corporation in 1972. In 1974 it was split into the Nepal Food Corporation and the Agricultural Inputs Corporation. Efforts were also made for extension education services. Tribhuvan Village Development Department was created in 1953. Also a school of agriculture was set up to train the village extension workers in 1957. It was upgraded to the status of agricultural college in 1968 for producing qualified technicians in agriculture. Agricultural Development Office with extension agents, viz., DADO, JT and JTA, was set up in various districts of the country. Later, specialists in the cereals, cash crops, livestock and horticulture have been made available to this office for the purpose of carrying out extension programme more effectively. Additional extension services were made available under Intensive Agricultural Development Programme carried out in some districts. Moreover, T and V system of extension services were also provided in some Terai districts. Besides the above, there are many other programmes, policies and strategies adopted by the government for the development of agriculture. An excellent resume of all those efforts is supplied by Joshi and Khatiwada.

THE PROBLEM

In the previous section, it has been mentioned that the geo-climatic, socio-cultural and institutional factors determine productivity on farms. Moreover, a brief resume of the major steps taken up by the government of Nepal for agricultural development has also been presented. Despite such great efforts the overall productivity of principal crops is not increasing. A study on the productivity trends of ten principal crops during the period 1965/66-1986/87 has been performed by the present author (Tiwari: 1988). The study observed that the productivity of paddy and potato, the most dominant food crop and cash crop respectively, did not show any significant trend during this period. Only the productivity of wheat among food crops and that of sugarcane, oilseeds, and jute among cash crops were found significantly increasing. Based on 1976/77 GDP they altogether contribute only 9.69 percent in the overall index of agricultural production. On the other hand, a statistically significant decrease had been observed for maize, millet and barley from food crops and tobacco from cash crops which, in total, share 14.81 percent in the total agricultural production. Thus, on the whole a significant decrease in the overall productivity of the ten principal crops has been observed during the 1965/66-1986/87. This result, of course, cannot be overlooked in the presence of such immense

efforts made by the government for the agricultural development in the country. Since productivity in agricultural sector is governed by large number of factors ranging from geo-climatic to institutional factors, the decrease in productivity is difficult to explain. However, in the presence of many institutional changes made so far, the unfavourable geoclimatic factors seem an augury of the decrease in productivity. This is what the government asserts very often. On the other hand, the decrease in agricultural productivity may imply dismal performance of agricultural development programmes. Obviously, this indicates that the programmes were motivated by political slogan and they have not been implemented effectively later. In this regard, it requires an assessment of the progress of various measures of the government. The assessment of all measures taken up by government is really a difficult task. It requires to undertake a comprehensive study on the progress of agricultural development programmes. In this light, the present study intends a modest attempt to observe the use of modern inputs such as chemical fertilizer, improved seed, plant protection materials, agricultural tools, irrigation and agricultural credit which have a significant bearing on productivity.

AVAILABILITY OF STATISTICS AND METHOD OF ANALYSIS

The data required for present topic are time series data concerned with the use of modern inputs. But the data on use of modern inputs as such are not available since the governmental agencies are not used to collecting information on modern inputs/resources actually used by farmers in crop production. The government rather assumes the total amount sold/distributed by its agencies as the amount actually used by farmers. For example, Agricultural Inputs Corporation (AIC) supplies improved seeds, chemical fertiliser, plant protection materials and agricultural tools to its branch offices, Sajha institutions and private dealers to sell to farmers, and thus keeps the record on the sale of these inputs. Its business is not to ascertain whether the sold amount are actually used or not. Similarly, Agricultural Development Bank (ADB/N) nas mainly engaged in disbursement and collection of loan, and keeps information on these activities. It has also directed its effort for the effective utilisation of distributed loan. However, it is difficult to reckon the amount of loan effectively utilised because ADB/N does not sort out all distributed loans deliberately. Therefore, some discrepancies are bound to occur between the sold/distributed amount and actually used amount of resources. Among others the extent of discrepancies also depends upon the honesty of the officials involved in the distribution activities of the resources. Despite all these the sale/distribution of resources has been treated as the use of resources in this study. It is done so because in the absence of any alternatives, the sold/distributed amounts can be taken as good proxies.

The sources of data are government publications. The publications of AIC and ADB/N are primary source of information. Based on these sources, Ministry of Finance (MOF), Department of Food and Agricultural Marketing Services (DFAMS), Nepal Rastra Bank (NRB), Central Bureau of Statistics (CBS) of Nepal also publish such information. Indeed, the

publications of the former group of institutions are not so regular than those of latter group of institutions. Partly due to this fact this study has mainly relied on the information brought out by the institutions which are not involved directly in the supply of modern inputs. In particular, the information on total sale/distribution of improved seeds, chemical fertiliser, agricultural loan has been extracted from DFAMS and MOF publications, and that on agricultural tools and irrigation from NRB publication and NPC publication respectively. AIC and MOF publications have been consulted for the rest one input, i.e., plant protection materials. Such ascertained time series data relating to total amount of resources are marshalled in different tables. Moreover, the data on gross cropped area for the period 1965/66-1981/82 has been taken out from Agricultural statistics of Nepal, published by DFAMS, and those for the period 1982/83-1986/87 were derived by summing up the cropped area under ten principal crops mentioned in economic survey 1987/88 published by HMG/N. To maintain homogeneity over the entire period 1965/66-1986/87, cropped area of only ten crops has been taken into account. With such determined gross cropped area, per hectare use of input has been computed by dividing total input with gross cropped area. Compared to total use the per hectare use of inputs bears much significance for the gross cropped area has been increasing annually (see Appendix Table A).

Besides table analysis, graphical analysis has also been intended for the analysis of the per hectare use of inputs over the years. In this regard, a graph comprising all the time series data on different inputs was proposed for determining their trends as well as for having a meaningful comparison among them. But because of the chronological heterogeneity and quantitative differences (value vs physical units) in data, it has become difficult to plot a graph of such type in spite of converting the data into fixed base indices. Therefore, discarding graph, trend equations have been devised in semilog and linear forms. To discern the trend, per hectare use of four resources, viz., improved seeds, chemical fertiliser, agricultural tools, and agricultural credit, which have long time series data, has been regressed separately with their respective time periods.

USE OF MODERN INPUTS

It is to increase the agricultural productivity that the HMG/N has made provision of different agricultural services. Chief among them are agricultural supply services and agricultural extension services. This study mainly focuses on agricultural supplies which are supplied by AIC. Furthermore, it extends to analyse the use/disbursement of agricultural credit and to catch a glimpse of the availability of irrigation facility. In such an endeavour, effort has been directed to envisage trends in the use of modern inputs in this section and then some computations have been performed to discern trends in the per hectare use of some inputs in the following section. To do so, hence, we proceed with a separate explanation of each input.

Improved Seeds

Past experiences signify that high yielding varieties of seeds used with suitable combination of other inputs could increase yield several

times compared to that of local varieties. Agricultural Inputs Corporation (AIC) and farmers are two existing sources for supply of seeds among farmers. In its early days AIC had procured seeds mainly from three sources: (a) progressive farmers, (b) government farms, and (c) import from India. In this regard, the Department of Agriculture has helped the Corporation in the technical aspect of recommending varieties, laboratory testing of the seeds before purchase and during storage, and protection of seeds against diseases, pests. Another source for the supply of seeds are farmers. The farmers when they introduce new improved seeds and find the result satisfactory, save some seeds for next season for their own purpose as well as for their kith and kin. This way it passes from farmers to farmers. But such a saving of improved varieties has largely degenerated them into local ones.

Although AIC imported seeds from India in its early days of establishment, it realised soon to produce improved varieties in the country. Consequently, it started producing some seeds from 1971/72 and became self-sufficient shortly after. In Table 1 are given the total amounts of improved seeds supplied by AIC during 1965/66-1986/87. The consumption of improved seeds in the country in the first year of the third plan was 145 mt. which reached 2411 mt. in 1986/87, the second year of the seventh plan. But the annual increase in the use of seeds is not continuous over the entire period 1965/66-1986/87. However, there is a discernible increase in its use during subsequent plan periods. For example, the use of improved seeds was 2606 mt. during the third plan, whereas the corresponding figure was 7453 mt. during the fourth plan. This exemplifies a 186.00 percent increase in the fourth plan over the third plan. Similarly, the use of improved seeds has exceeded by 63.84 percent in the fifth plan over the fourth plan and that in the sixth plan by 23.39 percent over its corresponding the fifth plan.

The use of improved seeds in the country is concentrated to paddy, maize, wheat, and some vegetables. The planwise data on the use of improved seeds for the former three crops are given in Table 2. The data mentioned for the seventh plan are target amount. Excluding the seventh plan the use of improved seeds for paddy is decreasing but that fo./ wheat is increasing (see Table 2). This implies that there is not a breakthrough in the use of improved seeds for paddy, the first of the all crops of Nepal.

Chemical Fertiliser

Of the various inputs required for enhancing agricultural production, chemical fertiliser is by far the most important one. In almost all developed countries it has played a vital role in the agricultural development since it was first produced in about 1840. It gives maximum response when combined with other inputs in a package deal. Nevertheless, crop yield can be increased by using it even with local seeds under traditional method of production.

Table 1
Use (Consumption) of Improved Seeds

Year	Total Use (metric ton)	Per Hectare Use (kg/ha)
Third Plan	2606 -	
1965/66	145	0.07
1966/67	302	0.15
1967/68	770	0.37
1968/69	728	0.34
1969/70	661	0.30
Fourth Plan	7453 (186.00)	
1970/71	475	0.21
1971/72	1135	0.50
1972/73	2083	0.93
1973/74	1826	0.78
1974/75	1934	0.82
Fifth Plan	12211 (63.84)	
1975/76	2064	0.86
1976/77	2275	0.94
1977/78	2532	1.02
1978/79	2421	0.97
1979/80	2919	1.19
Sixth Plan	15067 (23.39)	
1980/81	1824	0.72
1981/82	2566	1.00
1982/83	5641	2.13
1983/84	3000	1.12
1084/85	2036	0.72
Seventh Plan	4876	
1985/86	2465	0.83
1986/87	2411	0.82

Note: The figures in parentheses placed beside the amount of total use of improved seed during a plan period refer to percentage change in total use of improved seeds during a plan over that of its previous plan. This practice is also followed in Tables 3, 5 and 7.

Source: (1) HMG/N, DFAMS (1983), Agricultural Statistics of Nepal, 1983, Kathmandu: DFAMS, p. 283.

(2) HMG/N, MOF (1988), Economic Survey, F.Y. 1987-88, Kathmandu: MOF, p. 6 (Statistical Tables).

Table 2
Use of Improved Seeds of Different Crops Under Different Plans

(Percent)

Plans	Paddy	Wheat	Maize
Third Plan	33.85	61.39	4.48
Fourth Plan	17.07	79.59	3.35
Fifth Plan	11.63	83.13	5.25
Sixth Plan	11.18	83.67	5.15
Seventh Plan*	14.42	72.63	10.95

*Target.

Source: HMG/N, AIC (2045), The Role of Agricultural Inputs Corporation in Agricultural Production and Its Contribution in Mid-Western Development Region (in Nepali), Kathmandu: AIC, p. 5.

The application of fertiliser in Nepal was started in early fifties after the establishment of a fertiliser factory at Sindhri of Bihar in India. Nepal used to get an annual allotment up to 1,000 mt. Ammonium Sulphate from that factory. It was first imported in 1954 in a lot of about 100 mt. This used to be the only source of nitrogeneous fertiliser in Nepal until 1964 when HMG/N through National Trading Limited (NTL) imported 2,000 mt. Ammonium Sulphate from USSR. Some phosphatic and potassic fertiliser were also imported by private traders during this period. Bulk of this fertiliser was consumed in Kathmandu valley. With the establishment of Agricultural Supply Corporation in 1966 procurement of fertiliser was made from the world market on global tender basis, and distribution channels were created in various parts of the country. Consequently, the use of fertiliser has gone increasing in the following years which is evident from Table 3. The use of chemical fertiliser of 451 mt. in 1965/66, the starting year of the third plan, reached to 42829 mt. in 1984/85, the terminal year of the sixth plan. This exhibits a tremendous difference in a lapse of 19 years. Moreover, compared to improved seeds, its use has increased year after year continuously save the 1974/75 and 1975/76 (Table 1 cf. Table 3). As a result, the per hectare use of fertiliser has also increased in the consecutive years despite an yearly increase in the gross cropped area during that period (Table 3). It seems that the increased use of fertiliser gains its momentum in 1972/73 and then after a lapse of a decade, in 1982/83. Consequently, its per hectare use increased from 3.52 kg. in 1971/72 to 5.32 kg. in 1972/73, and from 9.32 kg. in 1981/82 to 11.82 kg. in 1982/83. Moreover, the annual increase in the use of fertiliser has also resulted in its increase over subsequent plans (see Table 3).

Table 3
Use (Sale) of Chemical Fertiliser by NPK

Year	Nutrients (metric ton)	Nutrients (kg/ha)
Third Plan	12422	
1965/66	451	0.23
1966/67	1452	0.73
1967/68	2734	1.31
1968/69	3200	1.50
1969/70	4585	2.09
Fourth Plan	51020 (310.72)	
1970/71	5406	2.42
1971/72	7968	3.52
1972/73	11900	5.32
1973/74	13088	5.62
1974/75	12658	5.36
Fifth Plan	84134 (64.90)	
1975/76	12266	5.08
1976/77	14894	6.14
1977/78	17467	7.05
1978/79	18543	7.44
1979/80	20964	8.53
Sixth Plan	157682 (87.42)	
1980/81	22458	8.88
1981/82	23817	9.32
1982/83	31279	11.82
1983/84	37299	13.89
1984/85	42829	15.20
Seventh Plan	88459	
1985/86	43408	14.68
1986/87	45051	15.29

Source: (1) HMG/N, DFAMS (1983), Agricultural Statistics of Nepal, 1983, Kathmandu: DFAMS, p. 282.

(2) HMG/N, MOF (1988), Economic Survey F.Y. 1987-88, Kathmandu: MOF, p. 6 (Statistical Tables).

Plant Protection Materials[1]

Plant protection materials play a vital role in the agricultural operation. Insects, pests, diseases, etc. cause substantial loss in agricultural production by damaging the standing crops and the grain storages. In the absence of authentic data the exact extent of loss could not be ascertained. However, it is estimated that every year one-fifth of the potential yield is lost. With the introduction of new high yielding varieties the risk is further increased because of their more susceptibility as compared to local indigeneous varieties, which are fairly resistant to diseases. So, the pesticides also comprise the package of green revolution. The third plan has emphasized on the effectiveness of plant protection measures. Accordingly, plant protection units were established by HMG/N at three places of three different regions in the country during this plan period to provide technical services to the farmers. But majority of farmers have not yet been convinced about the benefits of plant protection measures.

Although AIC has been supplying plant protection materials from its early days of establishment, the annual time series data is not available for entire period. Rather, whatever data are available, they are sketchy; planwise data are available for some periods, whereas annual data are available for some other periods. Moreover, they are expressed in value (Rs.) for some periods while for some other periods in physical units (kg/mt). In 1966, the sale of insecticides amounted to only 21,058 Rs. Again, its sale was limited to the Central Development Region even until the fourth year of the third plan. Some 418 thousands Rs. was the total sale during the third plan, which reached to 1867 thousand Rs. during the fourth plan. The latter amount is 346.00 percent higher than that of former. Similarly, an increase of 315.00 percent (7766 thousand Rs.) was recorded during the fifth plan over the fourth plan. The total sale of insecticides came out to be 15.99 thousand Rs. in the first year of the sixth plan (1980/81-1985/86), and those for other years are given in physical volume in the following Table 4.[2]

Table 4
Use of Insecticides

Year	Powder (Metric Ton)	Liquid (Litres)	Powder (kg/ha)	Liquid (Litre/ha)
1981/82	321	5245	0.13	0.002
1982/83	430	10699	0.16	0.004
1983/84	459	5315	0.17	0.002
1984/85	521	6551	0.18	0.002
1985/86	603	4859	0.20	0.002
1986/87	393	4572	0.13	0.002

Source: HMG/N, MOF (1988), Economic Survey, F.Y. 1987/88, Kathmandu: MOF, p. 6 (Statistical Tables).

The Table 4 signifies that there is not large enough increase in the use of insecticides to date. Therefore, much has to be done in this regard.

Agricultural Tools and Implements

Like in most of the other developing countries, the main sources of power in farming of Nepal are human labour and animal power which are the major components of traditional technology of farming. In this regard, the tools and implements represent those things which are required for the use of human and animal labour. Thus, they are simple tools rather than gigantic ones used in modern developed agriculture. For example, most of the farming families having a fair size of holding possess a pair of bullock or buffalo with a plow and/or a spade for plowing operation, and family labour with few sickles for harvesting operation.

Substantial increase in agricultural productivity could be achieved through the use of improved tools and implements. Having recognized this fact HMG/N established an Agricultural Tools Experiment-Cum-Production Centre at Birgunj in 1963 for conducting experiments on different tools and implements suitable to different regions of the country on the one hand, and manufacturing them for general distribution among the farmers at reasonable price on the other. Later, considering the need of the vast number of farmers a modern tools and implements factory was established at Birgunj in public sector in 1967. Recently, this factory has been producing some large tools like pumping set. This factory has appointed AIC as its sole distributor in the country. But AIC also imports some tractors and other modern tools according to the need of the country.

The total volume of sale of agricultural tools of AIC is given in Table 5. During the third plan the total sale amounted to 1619 thousand Rs. which levelled to 28307 thousand Rs. during the fourth plan. Thus the sale of the fourth plan surpassed that of the third plan by 1648.42 percent increase. But compared to the volume of sales of the fourth plan that of the fifth plan has decreased by 50.30 percent and came down to 14069 thousand Rs. However, it is still higher than that of the sixth plan (7504 thousand Rs.) which shows up a 46.66 percent decrease over fifth plan.[3] Thus, it is clear from above that the sale of tools is higher in the fourth and the fifth plans than that of the sixth plan. The reason behind this is that AIC has sold more tractors and pumping sets during these two plans. The glaring decrease of sales in the following plans over the fourth plan is a bad omen. As a result, per hectare use of tools has also been decreasing. Thus, it seems an onerous duty of the government to increase the use of tools in the country.

Irrigation Facilities

Unless crops are assured with enough water, green revolution cannot take place in its full swing. Because of such a import of irrigation facility, the government of Nepal has been emphasizing it under different plans. At present, the goverr ent besides constructing large dams and canals, has also been focusing on bores and tube-well by giving subsidy to the farmers.

Table 5
Sale of Agricultural Tools

Year	Thousand Rupees	Rs/ha.
Third Plan	1619	
1965/66	1	0.00
1966/67	23	0.01
1967/68	145	0.07
1968/69	305	0.14
1969/70	1145	0.52
Fourth Plan	28307 (1648.42)	
1970/71	979	0.44
1971/72	1358	0.60
1972/73	3186	1.42
1973/74	20925	8.99
1974/75	1859	0.79
Fifth Plan	14069 (-50.30)	
1975/76	4724	1.96
1976/77	3220	1.33
1977/78	2764	1.12
1978/79	1564	0.63
1979/80	1797	0.73
Sixth Plan	7504 (-46.66)	
1980/81	1217	0.48
1981/82	1061	0.42
1982/83	1601	0.60
1983/84	1843	0.69
1984/85	1782	0.63
Seventh Plan	2247	
1985/86	2247	0.76

Source: (1) HMG/N, DFAMS (1983), Agricultural Statistics of Nepal, 1983, Kathmandu: DFAMS, p. 286.

(2) NRB (1987), Some Important Statistics in Agriculture, Nepal, Kathmandu: NRB, Table 32.

The planwise data on the availability of irrigation facilities have been presented in Table 6. Before the inception of planned development effort in the country, the total land enjoying irrigation facilities was 6,228 ha. In the first year plan 5,200 ha. additional land were brought under irrigation, and in the sixth plan about 1,40,191 ha. land were converted into irrigated land. Total irrigation facilities available by the end of the sixth plan is 3,38,672 ha. However, this is very small amount in the felt need of agricultural development in Nepal.

Table 6
Irrigation Facilities During Different Periodic Plans

Before Plan	6,228 Hectare
First Plan	5,200 "
Second Plan	1,035 "
Third Plan	52,860 "
Fourth Plan	37,733 "
Fifth Plan	95,425 "
Sixth Plan	1,40,191 " (Est.)
Total	3,38,672

Source: HMG/N, NPC (1985), Sataun Yojana, 2042-47 (Seventh Plan, 1985-90), Kathmandu: National Planning Commission, p. 407.

Agricultural Credit

Credit has become increasingly important as a means of capital formation in agriculture. Again, its role has further increased under green revolution technology. Generally, green revolution is defined in terms of a package of agricultural inputs like fertiliser, hybrid seeds (some times called 'miracle' seeds), pesticides, herbicides, controlled water supply, and a variety of mechanical equipment. But in broad sense it incorporates not only a package of inputs but also a package of new agricultural practices, and these two together form the technology of high yield varieties. The above mentioned inputs are physical/real resources required for the success of green revolution, but all these resources reduce to a single resource, i.e., financial resource, provided that the physical resources are available in required quantity. Due to this fact the antagonists of green revolution assert that it is selective-selective in terms of farmers and in terms of crops, i.e., it is rich farmer biased and crop biased. Thus, to them it neither is widespread nor results in equal distribution of income. One of the reasons cited for glaring difference in the inequality of income between large farmers and small farmers is that small farmers are devoid of green revolution technology due to lack of financial resources. But the protagonists state green revolution

as a bio-chemical rather than a mechanical innovation. Thus, they opine that small farmers can also afford for green revolution technology. But the question is: Can the small farmers emulate the large farmers? They cannot, of course. In this context, therefore, the role of credit facility is of utmost importance specially to small farmers.

The Agricultural Development Bank of Nepal (ADB/N) has so far made a sharp dent on the front of credit disbursement from the day of its establishment. The disbursement of credit has been increasing successively under subsequent plans (see Table 7). To start with, a 192.72 percent increase was noticed during the fifth plan over the fourth plan (336.4 million Rs.). Table 7 also divulges an increase of 82.23 percent from 984.7 million to 1794.4 million Rs. in the sixth plan over the fifth plan. Such a planwise increase in credit has resulted in the increase in per hectare use of credit from 3.74 Rs. in 1968/69 to 207.33 Rs. in 1986/87. However, accounting for the inflationery trend in the Nepalese economy, this amount cannot be considered enough to farmers. Moreover, there are serious concerns relating to fair distribution, and use of the agricultural credit.

TRENDS IN THE (PER HECTARE) USE OF SOME INPUTS

In the previous section an attempt has been made to marshal the facts on the use of modern inputs and to explain those facts. The main focus was on the explanation for planwise use rather than annual use of inputs. This was so partly due to lack of annual data for some inputs and partly due to difficulty in making out a trend through eye observation. Although a successive increase was observed in the use of some inputs under the subsequent plans, in the annual data a discernible trend was observed only in chemical fertiliser. This was also the reason for a cursory explanation of the per hectare use of inputs mentioned in the preceding tables. To bridge over this, we proceed here to observe the trend in the per hectare use of only four inputs for which long time series data are available. They are improved seeds, chemical fertiliser, agricultural tools and agricultural credit. Their per hectare use/sale/disbursement etc., are once again presented in Table 8. A review of the facts presented in the table reveals again an increasing tendency in fertiliser, but not any discernible tendency in other inputs. It is evident from the table that there is a successive increase in the per hectare use of fertiliser except in 1974/75, 1975/76 and 1985/86, but in rest other inputs there are many ups and downs which did not permit to discern any tendency from the simple eye observation. Therefore, to search out the trends in those inputs the following semilog trend equations have been devised:

$$\text{Ln. (IS/GCA)} = a + bt + u$$

$$\text{Ln (CF/GCA)} = a + bt + u$$

$$\text{Ln (AT/GCA)} = a + bt + u$$

$$\text{Ln (AC/GCA)} = a + bt + u$$

Table 7
Disbursement of Agricultural Credit

Year	Million Rs.	Rs/ha.
Third Plan		
1968/69	8.0	3.74
1969/70	13.6	6.20
Fourth Plan	336.4	
1970/71	19.2	8.61
1971/72	23.4	10.33
1972/73	35.6	15.93
1973/74	76.4	32.82
1974/75	181.8	76.94
Fifth Plan	984.7 (192.72)	
1975/76	114.3	47.39
1976/77	222.0	91.51
1977/78	282.5	114.00
1978/79	218.0	87.41
1979/80	147.9	60.17
Sixth Plan	1794.4 (82.23)	
1980/81	134.1	53.02
1981/82	256.4	100.39
1982/83	345.8	130.69
1983/84	474.3	176.65
1984/85	583.8	207.24
Seventh Plan	1274.8	
1985/86	663.8	224.56
1986/87	611.0	207.33

Source: (1) HMG/N, DFAMS (1983), Agricultural Statistics of Nepal, 1983, Kathmandu: DFAMS, p. 297.

(2) HMG/N, MOF (1988), Economic Survey, F.Y. 1987-88, Kathmandu, MOF, p. 9 (Statistical Tables).

Table 8
Per Hectare Use/Consumption/Sale/Disbursement of Physical/Financial Inputs

Fiscal Year	Improved Seeds (kg/ha)	Chemical Fertiliser (Nutrients kg/ha)	Agricultural Tools (Rs/ha)	Agricultural Credit (Rs/ha)
1965/66	0.07	0.23	0.00	-
1966/67	0.15	0.73	0.01	-
1967/68	0.37	1.31	0.07	-
1968/69	0.34	1.50	0.14	3.74
1969/70	0.30	2.09	0.52	6.20
1970/71	0.21	2.42	0.44	8.61
1971/72	0.50	3.52	0.60	10.33
1972/73	0.93	5.32	1.42	15.93
1973/74	0.78	5.62	8.99	32.82
1974/75	0.82	5.36	0.79	76.94
1975/76	0.86	5.08	1.96	47.39
1976/77	0.94	6.14	1.33	91.51
1977/78	1.02	7.05	1.12	114.00
1978/79	0.97	7.44	0.63	87.41
1979/80	1.19	8.53	0.73	60.17
1980/81	0.72	8.88	0.48	53.02
1981/82	1.00	9.32	0.42	100.39
1982/83	2.13	11.82	0.60	130.69
1983/84	1.12	13.89	0.69	176.65
1984/85	0.72	15.20	0.63	207.24
1985/86	0.83	14.68	0.76	224.56
1986/87	0.82	15.29	-	207.33

where,

IS = Improved Seed (kg)
CF = Chemical Fertiliser (Nutrients kg)
AT = Agricultural Tools (Rs)
AC = Agricultural Credit (Rs)
GCA = Gross Cropped Area (ha)

t = trend variable (year; the base year/first year=1 for each input).
u = residual.

The above equations have been estimated based on the data given in Tables 1, 3, 5 and 7 for total amount of inputs, and in Appendix Table A for gross cropped area. Moreover, their linear counterparts have also been considered. Corresponding to four inputs/resources there are four data sets. In each data set both the models, semilog and linear models, have been run. Thus, in total there are eight estimated equations which are arranged in a sequential order. In this order the estimated semilog equation for an input is followed by the estimated linear equation of the same input, and then similarly for other inputs. Thus, equations (1.1) and (1.2) relate to improved seeds, equations (2.1) and (2.2) represent chemical fertiliser, and so on. The trend coefficients of both models show either positive or negative trend, but while the trend coefficient of semilog model identifies a relative change that of linear model indicates an absolute change with a change in the year.

The equations (1.1) and (1.2) are statistically significant at 1 percent level of significance. Thus, their positive trend coefficients indicate an increase in the per hectare use of improved seeds over the period 1965/66-1986/87. In particular, while equation (1.1) explains 9.14 percent increase, equation (1.2) depicts 0.05 kg. increase in the improved seeds per hectare with the year. The same is the case of fertiliser. But compared to improved seeds its rate of increase amounts to 15.36 percent or 0.73 kg. during the same period (equations 2.1 and 2.2). In case of agricultural tools the estimated results show a contrast pattern; the estimated semilog model, equation (3.1), is statistically significant, whereas its corresponding linear model, equation (3.2), is not. This signifies the use of alternative functional forms is necessary in applied research work. However, the positive trend coefficient of equation (3.1) shows an annual 17.08 percent increase in the per hectare sale of agricultural tools during the period 1965/66-1985/86. With regard to agricultural credit both estimated equations are statistically significant. They indicate a per annum increase of 20.78 percent or 11.86 Rs. over the period 1968/69-1986/87.

On the whole, it can be inferred from the above analysis that the trend rate of growth in the per hectare use of inputs/resources is positive and statistically significant during the periods under consideration.

Improved Seeds: N = 22

(1.1) $\ln (IS/GCA) = -1.5394 + 0.0914t$
(0.0173)
$R^2 = 0.5831$ (5.2890) *

(1.2) $IS/GCA = 0.2172 + 0.0475t$
(0.0111)
$R^2 = 0.4766$ (4.2671) *

Chemical Fertiliser: N = 22

(2.1) $\ln (CF/GCA) = -0.2201 + 0.1536t$
(0.0145)
$R^2 = 0.8479$ (10.5599) *

(2.2) $CF/GCA = -1.5060 + 0.7295t$
(0.0357)
$R^2 = 0.9542$ (20.4116) *

Agricultural Tools: N = 21

(3.1) $\ln (AT/GCA) = -2.7968 + 0.1708t$
(0.0627)
$R^2 = 0.2805$ (2.7216) **

(3.2) $AT/GCA = 1.0080 + 0.0050t$
(0.0694)
$R^2 = 0.0003$ (0.0721)

Agricultural Credit: N = 19

(4.1) $\ln (AC/GCA) = 1.8493 + 0.2078t$
(0.0213)
$R^2 = 0.8482$ (9.7456) *

(4.2) $AC/GCA = -31.5181 + 11.8620t$
(1.2667)
R^2 0.8376 (9.3648) *

Note: The smaller figures written in parentheses just below the trend coefficients are their standard errors; the larger ones written in the second set of parentheses are t-value.

* Significant at 1 percent level.

**Significant at 5 percent level.

CONCLUSION AND IMPLICATION

Overall productivity of ten principal crops has been decreasing in spite of the launch of the various agricultural development measures and programmes from the start of the third plan (1965-70) to date in the country. This situation could dismay any one. In such instance, one may deduce that whatever agricultural development programmes launched so far have theoretical underpinning and/or political colouring. With this problem, efforts were directed to examine the use of modern inputs/resources, which comprise green revolution technology in the Nepalese agriculture. The time series data on sale of improved seeds and chemical fertiliser for 1965/66-1986/87 and those of agricultural tools for 1965/66-1985/86, and planwise data of plant protection materials and irrigation facilities have been taken into account. Moreover, for financial resource institutional credit supplied by ADB/N from 1968/69 to 1986/87 has been taken up.

The total and per hectare use/sale of inputs have been analysed. Moreover, the latter one is extensively analysed by fitting semilog and linear trend equations for four resources whose long time series data were available. From the fit of the trend equation it has been inferred that, on the average, the per hectare use of all of the four inputs, namely, improved seeds, chemical fertiliser, agricultural tools, and agricultural credit, has been increasing during the period taken into consideration. Moreover, an analysis of planwise data also brings in positive results regarding the availability of irrigation facility and use of plant protection materials, although the use of latter one seems very little in the context of agricultural development in the country.

Thus, after the start of the third plan we have observed an increase in the use of modern inputs on the one hand, and a decrease in overall productivity on the other. These two phenomena are in contrast. Nonetheless, they manifest failure of green revolution technology in the country. But this failure may not be considerably disappointing if compared with those of other countries. There is a sharp controversy among economists regarding the impact of green revolution technology in the underdeveloped world. Most of them have come out with the following three results. The first is related to the relative failure of the high yielding varieties (HYV) programme among non-wheat crops, particularly rice, which is the main food crop in most under developed regions. The second is concerned with the growing inequality in the countryside, mainly because of the early adoption of new technology by large farmers, and the institutional bottlenecks which prevented the small farmers from participating in the programme in large scale. The third result is that the green revolution is concentrated only in few parts of a country, specially in advanced part/regions like Punjab and Haryana in case of India. Thus, green revolution is selective-selective in the case of area, crop, as well as farmer. Of course, such selectivity or biasedness is also evident in Nepal because it is concentrated to the large farmers of the Terai region, and is limited to paddy, maize and wheat crops. Furthermore, it is wheat crops biased, for the planwise use of improved seed is increasing in wheat but decreasing in paddy, and not a continuous increase for maize during 1965/66-1986/87 (see Table 2). Also, an increase in wheat productivity

but a decrease in paddy and maize productivities have been observed during the same period. Therefore, there is a very close correspondence between the use of improved seed of a crop and increase in its productivity. This may be the manifestation of the success of green revolution technology in terms of crops. But in the face of the implementation of various agricultural development programmes besides the adoption of green revolution technology the problem of decrease in the productivity of major crops like maize, potato cannot be underrated. It has, of course, grave consequences which could penetrate every part of the economy.

It is very difficult to adduce reasons for the decrease in productivity amidst of the so many programmes. Theoretically, the productivity in agricultural sector depends upon geoclimatic, sociocultural and institutional factors. Since large number of measures were implemented for the improvement of institutional framework of agriculture, the decrease in productivity may be attributed to the geoclimatic and sociocultural factors. Thus, the degrading social values and deteriorating geoclimatic condition may be adduced as the reasons for declining productivity. Of particular importance, in this context, are widely rampant demonstration effect, and annual destruction (flow) of 1.7 millimetres of fertile soil in the country (seventh plan: 1985 (Nepali), p. 177). Over and above, since this study has focussed only on modern inputs the decrease in productivity can be attributed even to the dismal performance of other developmental programmes such as Land Reform 1964 which strayed from the basic objective, i.e., distribution of land ownership (Regmi: 1976, p. 199). Again, some discrepencies are bound to occur between the distribution and use of resources. Many grievances are heard from poor farmers such as trepassing of the chemical fertiliser in India, and unavailability of resources in the period of cultivation. Moreover, they are not used in proper combination, and except improved seeds hardly is there any input used in adequate amount. Thus, the decrease in agricultural productivity has wide ramifications. However, a comprehensive study on the evaluation of institutional factors-related-development programmes could divulge the sources of decrease in productivity. If such an evaluation finds positive impact for institutional programmes, the decrease in productivity will be attributed to geoclimatic and sociocultural factors which, to the present author, seem very important. Therefore, an evaluation of those programmes is called for policy implication which could prevent from smashing the glassy, fragile ecosystem of the country.

NOTES

1. The plant protection materials include both the insecticides and pesticides. Although the terms 'insecticides' and 'pesticides' differ from each other they are used interchangeably in this article for the plant protection materials.

2. The source of the information for the total sale of insecticides under different plans is: ATC (2045), The Role of Agricultural Inputs Corporation in Agricultural Production and Its Contribution in the Mid-Western Development Region, Kathmandu: Agricultural Inputs Corporation, Paush 2045, pp. 7-8. The annual sales cited in Table 4

are taken from: HMG/N, MOF (1988), Economic Survey, 1987-88, Kathmandu: Ministry of Finance, 1988, p. 6. But these annual sales do not correspond with those presented in page eighteen of the above-mentioned bulletin of AIC. The reason for taking out these data from MOF publication is that we rather maintained uniformity regarding the use of annual data for different inputs.

3. The data on sale of agricultural tools during the sixth plan presented in Table 5 differs from those published in AIC (2045), The Role of Agricultural Inputs Corporation in Agricultural Production and Its Contribution in Mid-Western Development Region, Kathmandu: Agricultural Inputs Corporation, p. 19.

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Appendix A
Gross Cropped Area in Different Years

(Thousand Hectare)

Third Plan		Fourth Plan	
1965/66	1995	1970/71	2231
1966/67	1991	1971/72	2265
1967/68	2092	1972/73	2235
1968/69	2137	1973/74	2328
1969/70	2193	1974/75	2363
Fifth Plan		**Sixth Plan**	
1975/76	2412	1980/81	2529
1976/77	2426	1981/82	2554
1977/78	2478	1982/83	2646
1978/79	2494	1983/84	2685
1979/80	2458	1984/85	2817
Seventh Plan			
1985/86	2956		
1986/87	2947		

Source: (1) HMG/N, DFAMS (1983), Agricultural Statistics of Nepal, 1983, Kathmandu: Department of Food and Agricultural Marketing Services, p. 22.

(2) HMG/N, MOF (1988), Economic Survey, 1987-88, Kathmandu: Ministry of Finance, pp. 4-5.