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ECONOMICS OF LIVESTOCK PRODUCTION AND MANAGEMENT

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FOREWORD

Livestock sector constitutes an integral part of the agricultural economy of Pakistan. In terms of contribution towards national economy, livestock production activities made up over one third of the gross domestic product originating in the agriculture sector. Livestock production and marketing activities, in fact, provide a major source of livelihood to the landless and small farmers.

In recognition of the role of livestock sector in Pakistan's economy, the Agricultural Social Sciences Research Centre has, for the last one year, been working towards the preparation of a text. I am very pleased to see that the centre has finally produced and published a precise but very comprehensive document in form of a book titled "Economics of Livestock Production and Management in an economic context.

I am sure, this text will come up the expectation of all concerned with the development of livestock sector in pakistan. It will serve as a useful reference book both for students as researchers in Animal Sciences in particular and for others in general.

I congratulate Dr. Bashir Ahmad, Dr. Munir Ahmad and Mr. Muhammad Aslam Chaudhary for their interest and devotion bringing out this reference book of immense utility to us all.

October 29, 1996

(Dr. M. ANWAR-UL-HAQ)
VICE CHANCELLOR

ACKNOWLEDGEMENT

Preliminary thinking on this reference book Economics of Livestock Production and Management got, in fact, underway a year back on the wise counsel of Dr. Muhammad Anwar-ul-Haq, the Vice Chancellor (the then Dean, Faculty of Agricultural Economics and Rural Sociology). We are immensely grateful for his constant support and encouragement during the course of preparation of this document.

We are also thankful to Dr. Khalid Mehmood Khan, the then Director Research, who also liked the idea and provided every assistance in getting through the process of approval. We are equally indebted to Dr. Riaz Hussain Qureshi, the present Director Research for his highly positive attitude in making this effort a success.

We wish to extend our appreciation to Dr. Muhammad Aslam Chaudhary, Dean Faculty of Agricultural Economics and Rural Sociology, for his good wishes and encouragement in the smooth conduct of research activities of the Agricultural Social Sciences Research Centre.

Thanks are also due to other staff members of the Department of Farm Management and Agricultural Economics for their cooperation at all times.

The ministerial staff of the ASSRC rendered all the needed secretarial support in making this project a real success.

October 29, 1996

DR. BASHIR AHMAD
DR. MUNIR AHMAD
M.ASLAM CHAUDHARY

CHAPTER I

LIVESTOCK SECTOR IN THE ECONOMY OF PAKISTAN

Agriculture sector plays vital role in Pakistan's economy. It contributes around 24 percent to the Gross Domestic Product (GDP) of Pakistan. As the largest contributor towards national income, the agriculture sector broadly includes the sub-sectors of crops, livestock, fisheries, wild life and forestry. The livestock sub-sector accounts for about 36 percent of the agricultural GDP that is higher than even the major crops; while it shares 9 percent of national income. It is also a major source of foreign exchange earning (i.e., about 11%) through exports of woollen carpets, leather, and leather products, wool, hides, skins and other products of livestock origin.

Livestock production and marketing activities constitute an important source of livelihood of the poor landless and small farmers. Livestock sector provides nutritive food products like milk, beef, mutton, poultry and eggs that make up an important constituent of human diet in the country. A small part of these products is consumed at the farm and the rest is sold for cash to purchase other necessities of life[1].

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[1]Iqbal, M. "Major Constraints to Livestock Production in Pakistan". Paper Presented at the First SAARC Training Programme on Socio-Economic Techniques to Identify Constraints to Agricultural Production in Pakistan, Held at NARC, Islamabad, May 29-31, 1994.

The animal dung is an important source of organic manure which helps in conserving long term soil fertility. Moreover, it also improves the structure of the soil and helps restore micro-nutrient balance of soil in intensively cultivated areas.

Livestock Inventory and Growth

Table 1.1 provides detailed information about livestock population and changes in its composition and mix overtime. These trends are also depicted in Figure 1.1. The comparison of livestock population during 1970-71 with that of 1994-95 reveals that the cattle population increased at the composite rate of 1.10 percent annually (i.e., from 14.8 million to 17.8 million)[2]. Buffaloes increased at a compound rate of 3.22 percent per annum (i.e., 9.7 million in 1970-71 to 19.2 million in 1993-94). Goats experienced an annual increase of 4.14 percent, while sheeps increased at the rate of 2.29 percent during the period of 1971-1994. Maximum increase has been observed in the case of poultry, i.e., 9.40 percent per annum, during the same period.

The above mentioned trends show that the buffaloes population increased at an higher rate than that of cattle. Thus, dairy buffalo dominates the milk production system in Pakistan and accounts for almost three fourths of the total milk

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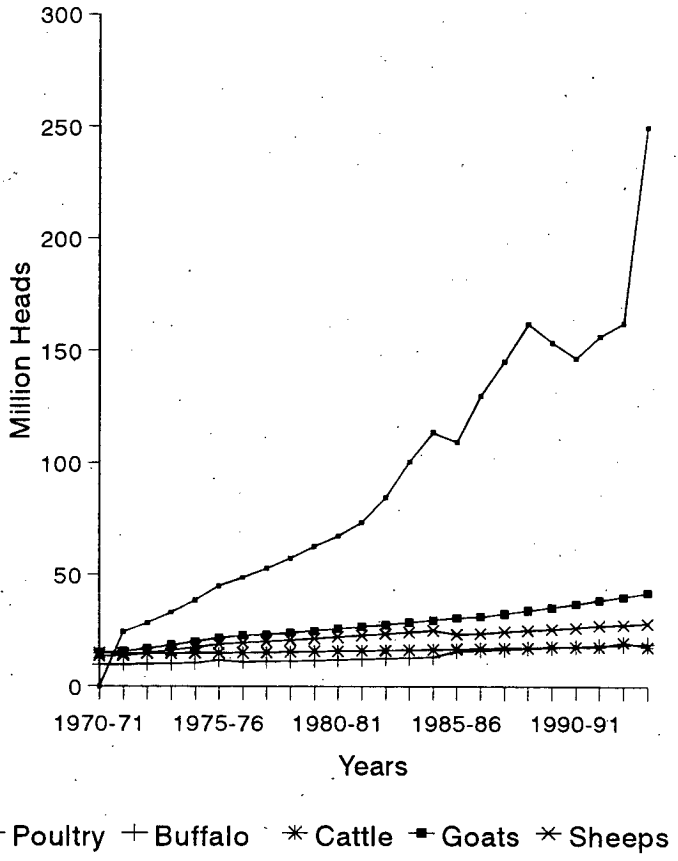
[2] Growth rates are computed using equation: $\ln(Y_t) = a + bt$, where $\ln(Y)$ represents the natural log of livestock population in year t, t is time period and b is regression coefficient. Annual growth rate can be computed by multiplying b with 100.

Table 1.1: **Trends in population (millions) of buffalo, cattle, goats, sheep and poultry.**

Year	Buffaloe	Cattle	Goats	Sheep	Poultry
1970-71	9.70	14.80	15.00	13.60	0.00
1971-72	9.80	14.60	15.60	13.70	24.30
1972-73	10.00	14.70	16.90	14.80	28.30
1973-74	10.20	14.70	18.40	16.10	33.00
1974-75	10.40	14.80	20.00	17.40	38.50
1975-76	11.60	14.90	21.70	18.90	44.90
1976-77	10.90	15.00	22.70	19.50	48.60
1977-78	11.10	15.20	23.20	20.10	52.70
1978-79	11.30	15.40	24.00	20.70	57.40
1979-80	11.60	15.60	24.90	21.40	62.60
1980-81	11.90	15.80	25.80	22.10	67.40
1981-82	12.10	15.90	26.70	22.80	73.50
1982-83	12.40	16.10	27.70	23.50	84.50
1983-84	12.70	16.30	28.70	24.20	100.60
1984-85	13.10	16.50	29.70	25.00	113.70
1985-86	15.70	16.70	30.80	23.30	109.50
1986-87	16.10	16.90	31.20	23.70	130.00
1987-88	16.50	17.10	32.60	24.50	145.40
1988-89	17.00	17.20	34.00	25.10	162.10
1989-90	17.40	17.80	35.40	25.70	153.90
1990-91	17.80	17.70	37.00	26.30	146.90
1991-92	18.30	17.70	38.70	27.40	156.70
1992-93	18.70	19.80	40.20	27.70	162.60
1993-94	19.20	17.80	42.00	28.30	250.00

Source: Government of Pakistan (1995), Economic Survey, 1994-95, Finance Division, Economic Advisor's Wing, Islamabad.

Figure 1.1: A Graphical Representation of Buffalo, Cattle, Sheeps, Goats and Poultry Population.



production. Among buffaloes, Nili-Ravi is the most productive breed and thus, is very popular in Pakistan. Cattle is an all-purpose animal, it is kept for milk and also for draught power. The demand for draught power has undoubtedly increased over time mainly because of higher cropping intensities as well as increase in net sown area. However, tractorization in agriculture has reduced the relative demand for animal power. The demand for cow milk is also low because of less fat contents than that of buffalo milk. Another important factor is that cattle is less tolerant to the hot summer as compared to buffalo[3]. However, the Sahiwal and the Red Sindhi breeds, which are most popular among the cattle, are comparatively more tolerant to hot months than Friesian and Jersey breeds. Nonetheless, buffaloes are also more productive as compared to cow and are known to be better converter of poor quality roughages into milk.[4]

Productivity and Growth

Animal productivity in Pakistan is very low as compared to developed countries. For example, average milk production per

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[3]Anjum, M. S., K. Lodhi, A.A. Raza, F. Walter, S. Krause (1989). "Pakistan Dairy Industry: Issues and Policy Alternatives". Special Report No. 14, Pakistan Economic Analysis Network Project, USAID.

[4]Patel, R.K. "Present Status and Promise of Dairying in India". Indian Journal of Agricultural Economics, vol. 48, 1993: 1-49.

cow in U.S.A. in 1990 was about 15000[5] lbs a year; while in Pakistan this average for cows was 1553 lbs per year and the average of both cows and buffaloes was 2500[6] lbs per year. This huge gap in milk productivity very clearly shows that we in Pakistan are producing only 17 percent of the practically achievable potential milk yield per animal.

Pakistan had a population of 10.722 million heads of milch cows and buffaloes in 1990-91, which produced 11.93 million tones of milk per year. In contrast, USA had 10.2 million milch cows producing about 67 million tones of milk. This low productivity of milch animals in Pakistan can mainly be attributed to the shortage of fodder and other feed supplies and higher disease incidence. Further, low animal productivity, on one hand, and higher growth in human population, on the other, have resulted in low per capita availability of major livestock products in the country.

Though not compatible with advanced world levels, our dairy sector has in fact, made significant progress during the past over two decades. Despite this satisfactory performance, Pakistan is still unable to fill the gap between supply and demand for livestock products. According to some estimates, however old, demand for milk and meat is increasing at the rate of about

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[5]United States Department of Agriculture. " Dairy Situation and Outlook Year Book, Washington D. C., 1993.

[6]Government of Pakistan. " Agricultural Statistics of Pakistan. Ministry of Food and Agriculture (Econ. Wing), 1991-92.

5 percent and 7 percent per annum, respectively[7]. On the other hand, a reference to Table 1.2 would show that milk production has increased from 7800 thousand tones in 1971-72 to 18006 thousand tones in 1993-94 at a composite rate of 3.97 percent annually. Total meat increased at the rate of 5.50 percent annually - 2.57 percent due to increase in beef, 1.96 percent attributable to mutton and the poultry shared about 0.97 percent.[8] If we look at the performance of beef, mutton and poultry as separate commodities, it will be seen that these have put up an annual increase of 4.31 percent, 5.86 percent and 12.01 percent, respectively, during the period 1970 to 994 (Figure 1.2). Egg production during this period increased by more than 8 times which amounted to growth rate of 9.95 percent per annum.

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[7]Government of Pakistan (1988). "Reports of the National Commission on Agriculture". Ministry of Food and Agriculture.

[8]

$$lnTM_t - lnTM_{t-1} = \beta_1 (lnBF_t - lnBF_{t-1}) + \beta_2 (lnMN_t - lnMN_{t-1}) + \beta_3 (lnPY_t - lnPY_{t-1})$$

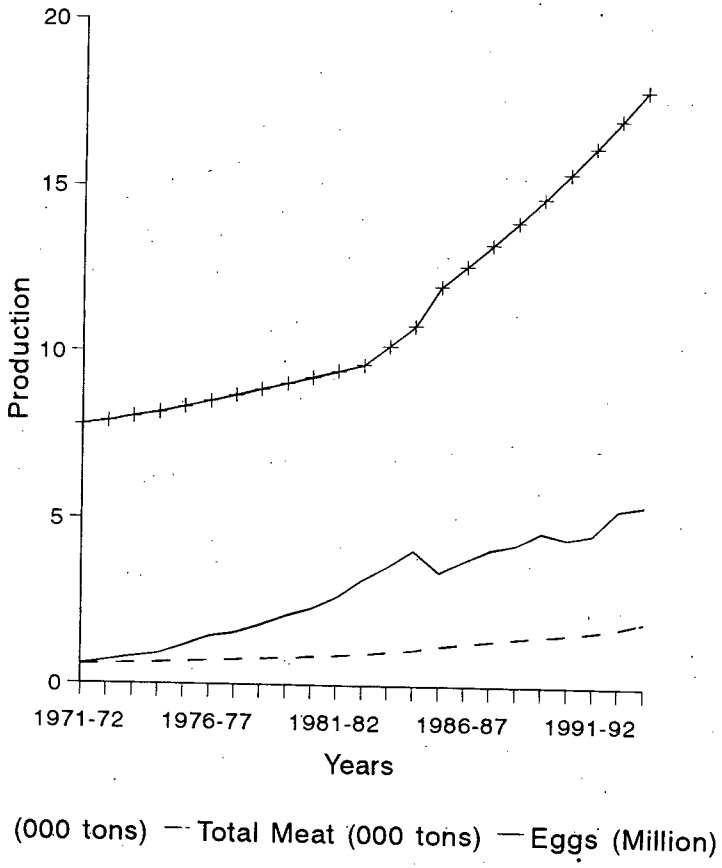
where TM is total meat (TM = BF+MN+PY), BF represents beef, MN is mutton, PY represents poultry and β_i are respective shares in total meat at time t. The term on right hand side gives rate of change in total meat at time t, which is composed of three components: 1) due to change in beef (first term on left hand side of the equation); 2) change attributable to mutton (second term on LHS of the equation); and 3) due to change in poultry meat (third term on LHS).

Table 1.2 Production Trend in Livestock Products (Figures in 000)

PERIOD	Milk	Beef	Mutton	Poultry	Total	Eggs
1971-72	7800	346	208	14	568	583
1972-73	7899	349	224	19	592	695
1973-74	8044	354	245	24	623	811
1974-75	8173	357	265	27	649	907
1975-76	8348	362	288	34	684	1159
1976-77	8524	376	303	37	716	1443
1977-78	8704	389	319	41	749	1557
1978-79	8888	404	335	44	783	1805
1979-80	9075	418	352	49	819	2094
1980-81	9267	434	370	52	856	2319
1981-82	9462	448	389	57	894	2664
1982-83	9662	464	408	75	947	3200
1983-84	10242	488	436	86	1010	3619
1984-85	10856	513	467	99	1079	4093
1985-86	12052	600	473	126	1199	3460
1986-87	12669	630	507	134	1271	3800
1987-88	13319	661	542	154	1357	4140
1988-89	14003	694	581	172	1447	4300
1989-90	14723	729	621	157	1507	4670
1990-91	15481	765	665	151	1581	4490
1991-92	16280	803	713	156	1672	4624
1992-93	17120	844	763	188	1795	5379
1993-94	18006	887	817	268	1972	5500

Source: Government of Pakistan (1995), Economic Survey, 1994-95, Finance Division, Economic Advisor's Wing, Islamabad.

Figure 1.2: A Graphical Representation of Trends in Milk, Meat and Egg Production From 1971-72 to 1993-94



Above facts manifest that our livestock sector has shown significant improvement over the last over two decades. However, the fact that embarrasses us all is that most of the increases that have been witnessed resulted from higher number of heads of animals, which indicates poor productivity per animal.

By increasing productivity per animal we would need to maintain less number of animals to feed and thus we could save area under fodder crops both in rabi and kharif seasons. The area thus released can help increase area under other important cash and food crops. Also, precious foreign exchange that is presently being spent on the import of edible oils, produced milk and pulses can be saved. Bringing more area under exportable crops like cotton and rice, would mean further addition to our foreign exchange reserves.

Dairy Farming: A Comparative View

In the western countries, commercial dairy farming is mainly based on feed grains or high green pastures. Besides this, milk producers in those countries are highly subsidized by their respective governments. On the other hand, cattle and buffaloes herds in Pakistan depend mainly on food stuffs like rice straw, wheat straw, maize, sorghum, millet, and other crop by-products and waste material. It is becoming difficult to allocate additional land to fodder because of increasing pressure of human population. In turn, number of cattle and buffaloes per acre of fodder is increasing over time, which is further deteriorating the feed and fodder situation for the livestock sector in Pakistan.

As for the structure of dairy farming in western countries, the number of dairy farms and total number of cows are declining over time, while stocking rates of cows per farm are on the increase which, in turn, is associated with significant increases in milk production per cow. The past dairy structure of USA shows that the number of dairy cows dropped from 21.9 million in 1950 to 9.84 million in 1992, while the total number of dairy farms decreased from 3.65 million to 0.22 million (17 times) in the same period[9]. As a result, the average number of dairy cows per farm has increased about eight fold.

In contrast, milk production in Pakistan is predominantly the realm of small and marginal land holders and the landless. Small farmers generally keep 1-2 milch animals as a part of mixed farming system, and they are holding about 38% of the total strength of milch animals[10]. According to another estimate, small farmers category having less than or equal to 12.5 acres (5 hectares) of land possess more than 73 percent of milch animals. The main agricultural activity of these farmers is, however, crop production. Additionally, they keep few animals for milk production either for home consumption or for sale as a supplementary source of income. Landless livestock

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[9]United States Department of Agriculture. " Dairy Situation and Outlook Year Book, Washington D. C., 1985 and 1993.

[10]Government of Pakistan. Agricultural Census of Pakistan, 1990.

owners have also become an increasingly important contributors towards agriculture sector. These households account for about one-third of non-farm households and they have been increasing their livestock ownership overtime; almost all of these households produce milk.[11]

An important feature of this lot is that these animals are spread over such a rural area which is equipped with poor infrastructural facilities for health cover, cattle insurance, Artificial Insemination, etc. Also, these livestock owners have meager resource endowment.

Feed and Fodder Availability

The major cause of low milk output per animal in Pakistan is that of shortage of feed and fodder. The quantity of feed and fodder fed to animals is far less than their daily appetite[12]. Moreover, nutrient contents of these feed and fodder supplies are also low. Since total feed intake not only serves as maintenance ration of the animal but also partially meets the feed needs for producing milk, it is evident that adequate feeding will have more than proportional effect on milk production.

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[11]Government of Pakistan (1988).

[12]Choudhry, A. Rauf (July, 1985). "Livestock Development in Pakistan". Pakistan Agriculture.

Iqbal (1994) in his study based on Malcolm and Hussain[13] has discussed various sources and requirements of feed in Pakistan. The sources of feed are rangelands, grazing at road sides, canal banks, grazing grass cutting from the national forests, and agro-industrial by-products. It will be observed from Table 1.3 that the crops sector contributes about 60 percent of TDN - - cereal straw (i.e., wheat and rice) provides 43 percent of total TDN and about 12 percent of DP, and the green fodder crops, i.e., berseem, sorghum and maize provide about 24 percent of crop's TDN and more than 42 percent of total crop DP. Rangelands supply 11 percent of the total TDN. Other sources include river banks, wastelands, road sides, fallow and forest grass. These together make significant contribution towards total feed resources. Iqbal (1994) further reports that cereal brans and grains contribute about 21 percent of crop DP. Cotton seed and rapeseed cakes supply about 12 percent of the DP generated from the crop sector.

The lower portion of Table 1.3 shows that the feed requirements are higher than the estimates of available feed energy and protein. This indicates that the whole herd is under

[13]Malcolm, H. and M. H. Hussain (1991). Pakistan Animal Feed Stuffs Policy Study. Prepared by the USAID, Pakistan Mission, Islamabad.

Table 1.3 Feed Sources, Total Nutrients Availability and Total Nutrients Requirement in Pakistan.

	TDN (million tons)	DP (million tons)
FEED SOURCES		
Crop sector	29.7	2.27
Rangelands	4.6	0.48
Other grazing	11.7	1.20
Other feed	1.3	0.37
Total Availability	**47.3**	**4.32**
FEED REQUIREMENT OF		
Buffaloes	22.69	1.93
Cattle	24.10	2.10
Sheep & Goats	8.52	0.90
Equine/Camels	4.02	0.35
Commercial Poultry	0.83	0.18
Total Requirement	**60.16**	**5.46**

Sources: FAO/ADB, 1987[14]; Malcolm and Hussein, 1991; Iqbal, 1994.

Note: according to Iqbal, these calculations have been made with the assumption that animals were only receiving 75 to 80 percent of the nutrients necessary to attain their full genetic potential, i.e., they were adjusted to their current production levels.

[14]FAO/ADB. Pakistan Livestock Sector Study. Report No. 55/87 AS-Pak 39.

nourished and, in turn, this deficiency reduces conception rate, diminishes lambing, lowers birth weight and increases mortality in youngsters.[15] The estimated shortfall is about 21 percent in both the cases, i.e., TDN and DP. According to some other estimates, animals receive even less than 70 percent of the required quantity of daily feed and fodder. At present, milch animals consume about 38 percent of all the available feed and fodder. If balanced feeding is provided to the milch animals alone, it would absorb 55 percent of the total available feed which, consequently, would further reduce the quantity of feed for the remaining herd.[16] This leads to an inevitable conclusion that if the animals are properly nourished - - availability of the feed throughout the year with some nutritional improvements, then per animal milk production as well as meat could be increased by more than 100 percent.[17]

Instead of expecting any improvement in feed situation, it is rather deteriorating further because of little scope for increasing the area under green fodder, since food grains, pulses and oilseeds are given high priority in the present system. Although the availability of dry fodder is not a problem, this, infact, is of poor quality in terms of certain nutrients and has low digestibility.[18] Moreover, the rangelands are continuously

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[15]Jasra, A.W. (1995). Rangeland a Renewable Source of Production. Progressive Farming, Vol. 15, No. 5.

[16]Government of Pakistan (1988).

[17]Government of Pakistan (1988).

[18]Patel, R. K. (1993).

being over grazed and animals carrying capacity on per acre basis is continuously diminishing.[19]

Over-time Public Sector Investment in Animal Husbandry and Dairying Sub-Sectors

Both volume of investment on animal husbandry and dairy programmes and its overtime trends show a clear neglect on the part of government. Table 1.4 and Figure 1.3 reveal that the share of livestock sector in GDP originating in the agriculture sector has increased over time at an annual rate of 1.53 percent from 30 percent in 1970-71 to 40 percent in 1993-94 at the current factor cost. Despite its significant contribution towards agriculture, the budgetary allocations made to the livestock sector do not match with the present level of its output and future potential for growth and development.

Allocations made to the livestock sector in various five year plans are given in Table 1.5 and also graphed as Figure 1.4, which show that the highest percentage allocation to livestock sector was a little over seven percent in only two recent five year plans (i.e. 6th and 7th FYP), while in others it remained below five percent. In contrast, the crop sector is being allocated more than 90 percent of the development expenditure on agriculture. Moreover, it was being supplied with subsidized inputs (i.e., fertilizers, water, tractors). Further, all the major crops are protected through a price support system for them. In the case of livestock, there has virtually been no price support, subsidy, or

[19]Government of Pakistan (1988).

Table 1.4: **Share of livestock in Agriculture and in over all economy.**

(millions)

Year	GNP of Agri. (1959-60)	GNP of Livestock	Share in Agri.	GNP of Agri. (current)	GNP of livestock	Share of livestock in Agri.
1960-61	7695	2887	37.52	8184	3064	37.44
1970-71	12188	3509	28.79	16236	4794	29.53
1971-72	12611	3579	28.38	17934	5053	28.18
1972-73	12821	3651	28.48	21907	6169	28.16
1973-74	13357	3724	27.88	28084	8247	29.37
1974-75	13074	3799	29.06	33533	9629	28.71
1975-76	13659	3875	28.37	38338	11130	29.03
1976-77	14004	3977	28.54	43968	13356	30.38
1977-78	14399	4133	28.70	50567	14272	28.22
1978-79	14845	4274	28.79	54147	14822	27.37
1979-80	15826	4418	27.92	62164	16668	26.81
1980-81	16405	4574	27.88	76399	20139	26.33
1981-82	16992	4742	27.91	92216	22810	24.74
1982-83	17637	4941	28.01	99380	26740	26.91
1983-84	16521	5251	31.69	104550	31396	30.03
1984-85	18600	5584	30.02	121293	36391	30.00
1985-86	19806	5943	30.00	128801	40858	31.72
1986-87	20967	6293	30.01	135308	46450	34.33
1987-88	21540	6651	30.88	156375	57438	36.73
1988-89	23018	7044	30.60	184074	65838	35.33
1989-90	23716	7473	31.51	197441	74237	37.60
1990-91	24160	7847	32.48	233130	86219	36.98
1991-92	26456	8314	31.43	282374	100726	35.67
1992-93	25059	8814	35.17	297816	117792	39.55
1993-94	25719	9341	36.24	343592	141191	40.39

Source: Government of Pakistan (1995), Economic Survey, 1994-95, Finance Division, Economic Advisor's Wing, Islamabad.

Figure 1.3: A Graphical Representation of Livestock Share in Agriculture at Constant Factor Cost and Current Factor Cost.

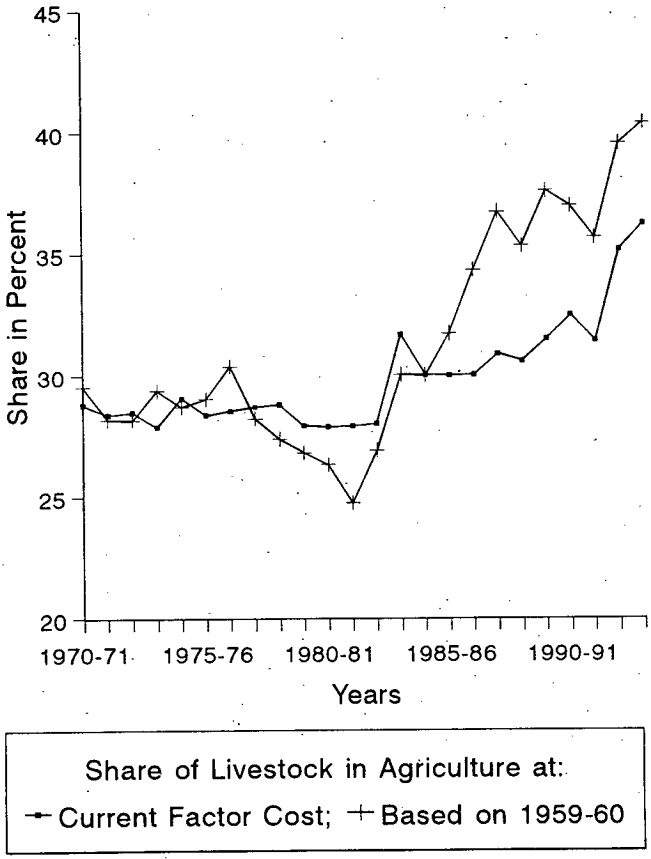


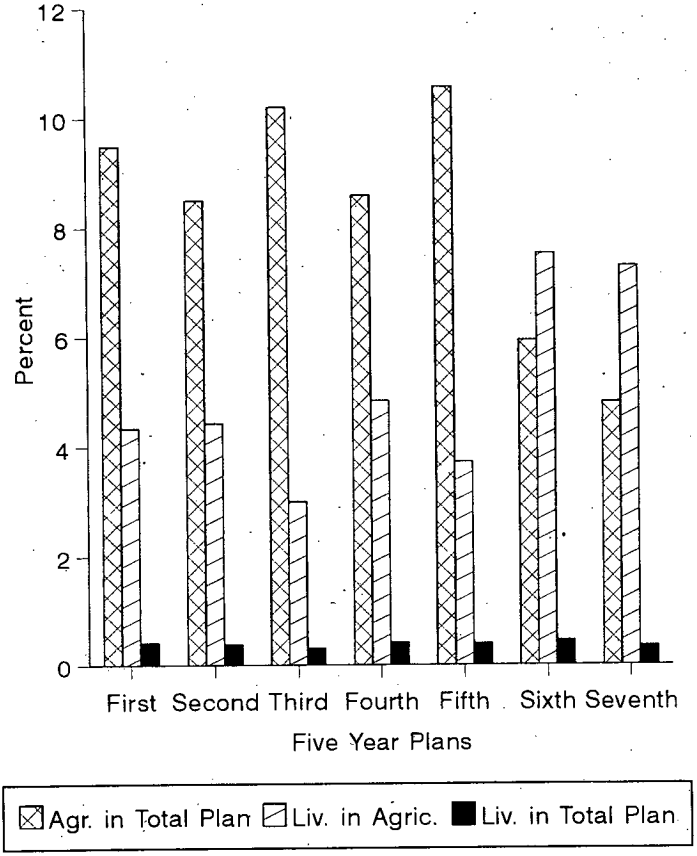
Table 1.5: Investment Pattern on Agriculture and Animal Husbandry During Various Development Plans.

Plan Period	Total Expenditure (million)	Agri. and allied activities (million)	Exp. A. H. Dairy (million)	Percent of Agriculture
First 1955-60	4860[a]	461[b] 9.49[c]	20[d] 0.41[e]	4.34[f]
Second 1960-65	10610	902 8.5	40 0.38	4.43
Third 1965-70	13500	1377 10.2	42 0.31	3.05
Fourth 1970-78	75540	6492 8.59	314 0.42	4.84
Fifth 1978-83	152610	16112 10.56	600 0.39	3.72
Sixth 1983-88	239747	14250 5.94	1071 0.45	7.52
Seventh 1988-93	324600	15600 4.81	1137 0.35	7.29

Note:- $c = (b/a) \times 100$ $e = (d/a) \times 100$ $f = (d/b) \times 100$

Source:- Government of Pakistan (1995), Economic Survey, 1994-95, Finance Division, Economic Advisor's Wing, Islamabad.

Figure 1.4: A Graphical Representation of Financial Allocation to Agriculture and Livestock Sector.



development outlay. On the contrary this sector has rather been discriminated by forcing prices of livestock products below cost of production and by the imposition of heavy export tax levies on exported livestock products.

In short, the existing poor conditions of the livestock sector cannot be ameliorated without a clear-cut change in the priority setting in the public sector planned development programmes for the agriculture sector. Budget allocation in various development plans is a clear evidence of the keenness of the government in developing this highly valuable sector.

CHAPTER II

CONSTRAINTS IN THE DEVELOPMENT OF LIVESTOCK SECTOR

Constraints and Policy Suggestions

Strategic plans for dairy development are constrained by many factors. These constraints are manifold by nature. There are cultural constraints which means that the farmers need to be convinced for shifting from subsistence farming to market oriented activities that are beneficial for them as well as for the society as a whole.[20] There are biological constraints like unavailability of good quality fodder and feed resources. More important biological constraints deal with the genetic capacity of the present herd in the conversion of feed to produce meat and milk. More specific problems in the present system are elaborated below.

Market Constraints

Good marketing system plays a key role in improving quality and productivity of any commodity/product. Milk and meat are the major products of livestock sector. The poor outlet system of these products is considered to be a major cause of low livestock productivity. Presently, livestock marketing system is so ill-managed that the farmers do not receive a fair share in

[20]Government of Pakistan (1988).

consumer's price, which in turn reduces the incentive for enhancing productive efficiency of animals.

Mainly because of poor milk collection system, more than 70 percent of the produce does not even enter the marketing channel and the milk produced in the remote areas is either consumed at home or is converted into ghee.[21] However, marketable surplus has increased in close vicinities of urban areas. The reason for this trend is that there has come about a reduction in ghee production from milk and also because of substantial substitution of ghee with dalda and other cooking oils, which are comparatively cheap. Cost of production of ghee from milk is also very high since one kg of ghee would require approximately 18 to 24 kgs of raw milk. Thus, it is profitable to sell fresh milk. More importantly, marketing services are better and milk is better priced as compared to the distant remote areas.

Anjum et. al. (1989) have discussed the (then) present milk marketing system and have reported that it was dominated by peddlers, also called "katcha dodhies". They gather a significant amount of milk from the village households and carry it either on bi-cycle or motor cycle. The milk is sold either directly to the urban consumers or to the pacca dodhi, who is a second stage milk collector and has a larger carrying capacity, e.g., a horse driven cart or a small pick up truck. These second stage dealers deliver the milk to some other collection centers, milk plants or de-creamers. The de-creamers either provide services to pacca dodhi or do business by themselves and separate whole milk into cream and skimmed milk. Afterwards, the skimmed

[21]Government of Pakistan (1988).

milk is either mixed with other whole milk or powder milk and, then, distributed to urban consumers through retail milk shops.

Poor marketing system is also due to the poor infrastructural development in the rural areas. This results in substantial quantitative losses during transportation from rural to urban areas, particularly in summer months.

The milk is also being routed to milk plants where it is converted into cheese, powdered and pasteurized milk. A number of small industries also process the surplus milk into yogurt, lassi and desighee. Milk is also being commercially pasteurized and treated with ultra high temperature (UHT).

It is to be noted that there are some serious reservations about the production of UHT milk. It is being produced at a very high cost. Consequently, the demand for this milk is shaky. One of the main reasons for the high cost of UHT milk is the packaging cost which accounts for about one-fourth of the total cost[22]. According to another estimate, this cost is even higher, i.e., about 35 percent of the total product cost. This cost, in any case is higher than is warranted by the international standards. It should be around 15 percent.[23]

The whole marketing setup is very complex and has failed to transmit the such needed price signals and preferences of final consumers to the milk producers. More importantly, the

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[22]Anjum et al.

[23]Choudhry, Ilyas M (August 1989). "Dairy Production." Pakistan Agriculture.

producers are not given any premium for milk production during hot summer as well as for milk having high fat contents.[24]

As regards the cost of milk production and the prices received by the farmers, it has been estimated that the cost of milk production, including the labor, was higher than the price of milk which producers were getting under the existing marketing system.[25] The milk producers were obliged to sell milk to katcha dodhies at a low price, since the opportunity cost of their labour elsewhere was very low. Moreover, as it has been mentioned earlier in Chapter 1 that most of the livestock owners keep only one or two heads of buffaloes/cows, it is difficult for them to market a few liters of milk by themselves. Consequently, the only alternative that could save the farmers from the village milk vendors and the existing system was the cooperative milk marketing. It is only through such an arrangement that they would be able to safeguard their common interest, i.e., a profitable milk marketing. That, in turn, would help increase the productivity of milch animals and also provide incentive to the milk producers to reap the benefits from economies of scale. It would help reduce marketing costs of milk and the cooperatives will thus be in a better position to win a better bargain for the output price.

In addition to the above facts, livestock marketing system is also equally defective. There exist designated livestock marketing places, spread over the whole country where formal

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[24]Anjum et al (1989).

[25]Choudhry, A.M. and Bashir Ahmad. "Cost of Production of Milk and Beef in Faisalabad District 1981-82". PARCB. and UAF., 1987.

transactions for the sale and purchase of animals for milk, meat and draught purposes take place. These places have turned out to be very profitable for the big merchants who would generally buy truck loads of animals from these markets and then haul them to the big urban centres. These intermediaries take advantage of the weak bargaining position of the rural poor livestock farmers, who in fact come to sell their animals to meet some of their cash needs. This situation creates an environment of competition among the sellers, that best suites the interests of the buyers. They thus exploit the former by paying lower prices and consequently, enjoy high margins by selling these animals in the big urban markets.[26]

Paucity of Health and Extension Services

Appropriate health cover, better feed management and improved breeding are the most important ingredients in effecting improvement in the livestock sector productivity levels. Presently, these services are highly inadequate in this sector. These inadequacies, in turn, adversely affect productive efficiency of the animals leading to very low return to the farmers.

Public sector veterinary service is presently the only source for animal health cover in Pakistan. There are a good number of veterinary hospitals, dispensaries and centers at various locations of the country. According to the available information, there are more than 2000 hospitals/centers in the Punjab province only; wherein about 827 veterinary graduates and about 2400

[26]Government of Pakistan (1988).

para veterinary staff is employed.[27] However, these hospitals/centers are poorly equipped in terms of medicine, vaccines, medical equipments, etc and virtually have no transportation facility.

As regards the vaccination of animals, the coverage is far less than the actual requirements to minimize the incidence of disease. Iqbal (1994) reported that about 26 million doses of vaccine is being produced currently for ruminants and 160 to 675 million doses for poultry. He further reported that the livestock number actually being vaccinated every year was not more than 10 percent of the total population. Consequently, due mainly to inadequate health coverage, livestock sector is facing losses worth millions of rupees every year. For example, this loss in 1978 was estimated to be around US$ 171 million due only to Foot and Mouth disease (FMD) of buffalo and cattle (Table 2.1).

Table 2.1 Estimated Losses from Foot and Mouth Disease in Pakistan (Thousand US $)

Province	Buffalo			Cattle			
	Dairy	Draught	Young	Dairy	Draught	Young	Total
Baluchistan	81	3	14	674	1012	222	2006
NWFP	4449	133	601	6649	6309	1821	18982
Punjab	62031	672	9541	19774	34189	6385	132592
Sindh	5223	38	908	3258	6247	928	16602
Total	71784	846	11604	30355	47757	9358	171162

Source: U.K. Ministry of Overseas Development (1978) adopted from Iqbal (1994).

[27]Pirzada, W. H. Livestock Production and Veterinary Services. A Paper Presented at DSE Course on Animal Health Planning and Management in Germany, 7-10 November 1993.

Extension and education constitute important elements in promoting livestock sector productivities. These services significantly help in improving management capabilities of the livestock farmers. Presently, these services are virtually non-existant in the country. The livestock extension service has nonetheless been established in the Punjab province by the Livestock and Dairy Development Department. Unfortunately, most of the concerned staff is composed of pure veterinarians, and practically have no training in livestock management.

Proper management and feeding of animals can, to a reasonable extent, prevent systemic diseases. Better management depend on better education. Thus, the farmers need to be educated about the likely benefits of adopting scientific practices on feeding calves, weight gain and on the care of pregnant animals. They must also be educated of the need for comfort of the animals, well-ventilated barns, saving the animals from low and high temperature and timely detection of heat and subsequent service arrangement.[28] For an healthy breakthrough in livestock sector, the services of the animal nutritionists and management personnel will essentially be needed.

Services of the extension agents are also required for the dissemination of available improved technologies, which have been successfully tested at the research institutions in Pakistan. Most pertinent of these technologies are those which are concerned with the increase in nutritive value of dry roughage by treating straw with alkali/urea; productive use of animal wastes-

[28]Wahid, A. (1988). Dairy Development in Pakistan. Dairy Production Potential and Challenges, Proceedings of a National Seminar Held in Faisalabad, 29-30 May 1988.

poultry litter; and the feed supplementation with molasses and urea that are cheap sources of energy and nitrogen.[29] Sial et. al. (1988) have further pointed out that straw treatment with alkali could increase its nutritive value by about 20%-30%; one kg of molasses per animal per day has been estimated to make available up to 0.80 kg of TDN per animal per day. However, the farm households who maintain most of the livestock do not have the needed resources and technical know how to adopt these technologies.

A closer look at the Department of agricultural extension reveals that activities of the extension workers, if any, are mostly concentrated on food and cash crops for the dissemination of scientific knowledge to enhance crop productivities. Green fodders, as important inputs of the livestock sector, do not receive much attention in their scheme of activities. There exists an enormous unrealized potential even in the case of existing fodder crops. Table 2.2 shows that in the case of Sorghum the farmers are exploiting only 36 percent of the potential yield obtained at the research stations. Present farm level yields can be improved upto 44 percent, 38 percent, 50 percent and 50 percent in the cases of Berseem, Maize, B. N. Hybrid and S. S. Hybrid, respectively with proper dissemination of extension advice to the farmers.

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[29]Sial, M.A., M. Z. Alam and G. Ali. (1988). Livestock Feed Resources and Requirement Scenario of Pakistan. Dairy Production Potential and Challenges, Proceedings of a National Seminar Held in Faisalabad, 29-30 May.

Table 2.2 Productivity levels of various fodder crops

Crops	Research Stations (MT/acre)	Farmers Field (MT)
Berseem	50.00	22.20
Sorghum	25.90	9.25
Maize	29.60	11.10
B.N. Hybrid	60.00	30.00
S.S. Hybrid	50.00	25.00

Source: Choudhry, M. H. (1983). Developments in Fodder Production in Punjab. Progressive Farming, Vol. 3, No. 4.

Range Management

Most of our livestock is presently being supported by rangelands. For example, Sheep and Goats obtain more than 60 percent of their feed from rangeland; 40 percent of feed for horses, donkeys and Camels; and 5 percent Cattle feed intake comes from this source, which sums to 13 percent of the total feed available for the livestock.[50] Moreover, grazing of riverain areas and flood plains also contribute a significant amount of TDN.[51] Consequently, there is a strong need to

[50]Mohammad, N., Rakhshan Rohi and C.M. Anwar Khan (1985). Desert Rangeland Rehabilitation in Pakistan. Pakistan Agriculture, July 1985.

[51]FAO/World Bank (1974). Pakistan Livestock Survey Report, Rome.

conserve this important feed source from destruction. Currently, range and other grazing lands are being misused by way of over grazing. The productivity of these lands is being adversely affected. Due to this mismanagement, these sources are only producing 15 percent of their potential, while a simple scientific management can increase the productivity of this resource by 10 times.[32] Jasra (1995) further reports that 55 percent of Pakistan's rangeland now falls under the rank of low productivity, i.e., 12-16 hectares of rangeland support one animal unit, while 5-6 hectares of productive grazing could provide enough feed for one animal unit. The existence of the latter is only 15 percent in Pakistan.

One major factor responsible for the destruction of range lands is that of the administrative mismanagement. The rangelands are controlled by the Forestry Department, which presently receives relatively low priority in funding for development. The department thus is not fully able to utilize this natural resource.[33]

Range lands can effectively be managed with the community participation that, in turn, would ensure conservation and use of this important resource on sustainable basis.

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[32]Jasra, A. W. (1995).

[33]Jasra, A.W., A. Ali and M. A. Sial (1993). Restoring Rangelands for Improving Livestock Production in Pakistan. Asian Livestock. FAO, Bangkok, Thailand, Vol. XVIII No. 6; and Iqbal, M. (1994).

Low genetic Potential

Government policies are tilted towards animal health services. Animal production sector receives relatively less attention. Animal health service is essentially crucial to achieving high levels of productivity. Unfortunately, however, we are facing a far serious constraint of poor genetic potential. That need to be improved first and then fully exploited using better health coverage and nutritionally balanced food. According to Akram et. al.[34], necessary components of genetic improvement programme specifically for milk are: a) an intensive animal identification system; b) production testing record system to measure individual performance standards for superior individual animals; and d) a breeding system such as artificial insemination. These programmes are presently almost non-existent in Pakistan.

The history of cattle breeding in Indo-Pak. goes back to eighteenth century. Shorthorn x native crossing led to the development of Taylor breed of Bihar, India, in 1856, and Ayrshin and Shorthorn bulls were introduced at the military dairy farms in 1875 for the first time.[35] Nonetheless, cross breeding did not receive any appreciation until 1954. Cattle crossbreeding is, of course, now the national policy in India,

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[34]Akram, M., Hanjra, Sadaqat Hayat and Nawaz, Shah (1988). Factors Affecting Dairy Production in Pakistan. Dairy Production Potentials and Challenges. Proceedings of a National Seminar Held in Faisalabad, 29-30 May.

[35]Payne, W.J.A. (1970). Cattle Production in the Tropics Vol. I. Breeds and Breeding. Trop. Agric. Series. Longman Group Ltd., London.

where it is being pursued through more than 7000 artificial insemination centers dealing with 10 million crossbred[36] head of animals.

In contrast, cattle crossbreeding remained a controversial issue in Pakistan for a long time. Efforts are now being made to improve the productivity of native cattle breeds through crossing with exotic semen (i.e., Friesian, Jersey, AIS, Black Welch, Chinese Black and White, Swedish Red and White, etc) on government owned livestock stations.[37] Khan (1994) further reports that the government farms have also involved Sahiwal, Red Sindhi and Therparker Breeds. However, no improvement seems to have been made in this regard in the public and private sector due to poor infrastructure, further compounded by interrupted supply of semen and unorganized breeding programmes.

Our breed improvement work is mainly based on artificial insemination, which is being carried out through not more than 160 AI centers and 470 subcenters throughout the country[38]. Because of a limited number AI centers, this activity is being carried out just around the centers, again at a limited scale. The feed back is not encouraging. As reported by the Livestock

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[36]Choudhary, M.Z. 1986. Productive and Reproductive Performance of Crossbred Cattle in India and Sri Lanka - A Review. In Proc. Ntl. Wrkshp. Dairy Cattle Crossbreed and maintain of Exotic Dairy Cattle in Pakistan. 13-15 July at NARC, Islamabad; and Khan, U.N (1994).

[37]Khan (1994).

[38]Akram et al. (1988).

Census (1986);[39] only 3 percent of the total cows and 2 percemt of the total buffaloes were inseminated during March 1985 to February 1986. The reasons reported by the farmers for not adopting such an important practice were: 35 percent of the households showed their concern that they did not like this technology; 50 percent of the households were of the opinion that the insemination centers are located too far away; only 6 percent blamed that the service was costly; and 5 percent of the households abandoned the use of AI service because of unsatisfactory results.

[39]Government of Pakistan (1986). Pakistan Census of Livestock 1986: All Pakistan Report. Agricultural Census Organization, Statistical Division, Lahore.

CHAPTER III

ECONOMIC PRINCIPLES OF PRODUCTION

There are physical and mathematical relationships between the levels of inputs used and output realized in a production process. Generally, a level of fixed resources, higher levels of output can only be obtained by adding more of variable resources. It is thus important to be able to identify the profitable levels of inputs to combine with a given level of fixed resources. This chapter describes the concepts necessary to identify the profitable use of variable inputs in a production process relevant both to crop and livestock enterprises.

PRODUCTION RELATIONSHIPS

In a production process, several **inputs** (factors of production) are used, which ultimately are transformed into final **output** (product) or outputs. One must choose the levels of each input, say, for instance, seed, fertilizer, feeds, concentrates, etc., that will, when transformed by the production process, produce the quantities and qualities of output(s) that best satisfy the farmer's goals.

This relationship between factors of production and output can be expressed as

$$Y = f(X_1, X_2, X_3, \ldots, X_n) \qquad 1$$

where Y is the output that is obtained as a result of using inputs X_1, X_2, etc. In the above equation, Y is used to denote a quantity

of output, such as tons of grain, kilograms of milk or meat, dozens of eggs, while X_1 and X_2 represent units of specific inputs, such as kilograms of fertilizers or tons of green fodder.

The quantities X and Y are called **variables** because variations in one of these quantities are associated with variations in the other. The expression $Y = f(X)$ means that Y is a function of X (that X affects Y). The production function is a mathematical statement about the relationship between X and Y once these two variables are defined.

Three basic relationships are studied in production economics, which are:

FACTOR-PRODUCT RELATIONSHIP -- output (product) is related to a single variable production input (factor) given a set of fixed inputs;

FACTOR-FACTOR RELATIONSHIP -- output (Product) is related to two or more variable production inputs (factors).

PRODUCT-PRODUCT RELATIONSHIP -- the relative quantity of two or more outputs (Products) is related to a fixed quantity of inputs (factors).

FACTOR-PRODUCT RELATIONSHIP

The production of any final product depends on the use of various inputs or factors of production. Such factors in the case of Livestock and Livestock products would be Labour, fodder, wheat straw, concentrates, buildings, medicines, machinery, management, technology, etc. Production may be affected by the use of one or all of these factors. The important aspect here is

that since the production does not vary evenly in response to uniform alterations in inputs and thus, the management have to decide the quantity to be produced and the amount and type of inputs to be used in the production process. Because of these variations in production responses to uniform applications of inputs, the decision maker is supposed to know the economic principles of production.

PRODUCTION FUNCTION

The physical relationship between inputs (factors) and the output (product) is called the production function. Let us discuss a production relation where only one variable input of production combined with the fixed inputs is used to produce only one product. Suppose the output is milk. Production of milk is a function of or depends on ration intake, i.e., total digestible nutrients (TDN), while all other inputs are held constant at a fixed level. The production function would, thus, look like

$$2. \qquad Y = f(X_1 | X_2, \ldots, X_n),$$

where Y is the milk production per cow per lactation and X_1 represents the ration (TDN intake) per lactation per cow. Variables X_2 to X_n, which are right of the bar, are fixed inputs used to produce the milk output such as labour, medical treatment, machinery, technology and etc. Such a production relationship is known as factor-product relationship. More briefly, Equation 2 may be written as

$$3. \qquad Y = f(X_1).$$

Considering single input-output relationship, we can tabulate the levels of X_1 used and corresponding levels of Y. Columns 1 and 2 of Table 3.1 show how output varies as the variable input (Ration) changes. Column 6 tells us the additional output which results from an additional unit of ration that is called "**marginal product**".

The information presented in Table 3.1 can be summarized as a production function curve, i.e., a graphical representation. This curve describes the relationship between the input (X_1) and output (Y). Figure 3.1 is the production function that displays the information given in Table 3.1. The number of ration doses are shown on the horizontal axis and the milk output is depicted on the vertical axis.

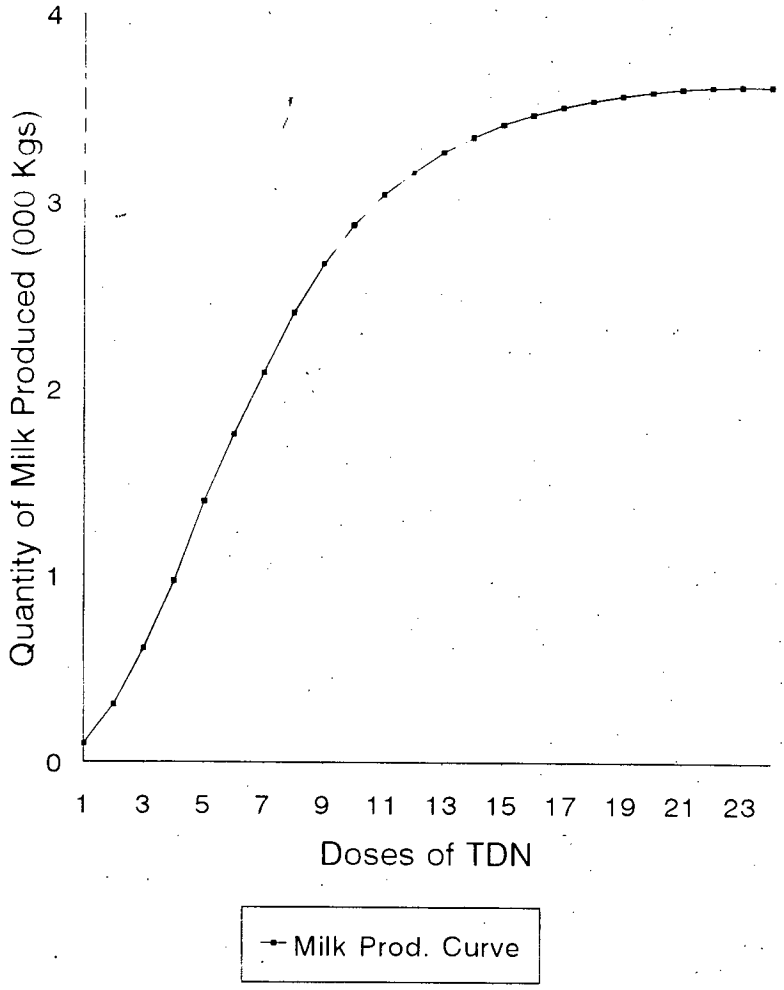
The shape of the curve in Figure 3.1 shows that the output increases at an increasing rate as the level of input increases to 5 units (1400 kgs of TDN). Between input levels 5 and 23 (4100 kgs TDN) output still increases as a result of increasing input levels, but at a decreasing rate. Further increase of input by one unit, i.e., 24th dose does not increase the total output. However, any further increase in input level, i.e., beyond 24th unit (4200 kgs of TDN) causes a fall in the level of total output (e.g., might be due to stomach upset). Consequently, the production function demonstrates diminishing returns to the variable factor. Thus, the law of diminishing returns may be stated as follows:

> "if equal increments of one factor of production to other factors of production are applied, which are kept fixed at a certain level, then the resulting additional output will decline beyond some point",
>
> or
>
> "if the quantity of any one factor of production is fixed, the application to that factor of equal successive increments of

Table 3.1: Milk Response to TDN

Doses of TDN (X)	Total Milk Per Cow (Kgs) (Y)	Change in Milk (Kgs) (Δ Y)	Average Product (Kg) (Y/X)	Marginal Product (Kgs) (Δ Y/ Δ X)
1	100	-	100	-
2	310	210	155	210
3	611	301	204	301
4	972	361	243	361
5	1399	427	280	427
6	1757	358	293	358
7	2088	331	298	331
8	2412	324	302	324
9	2673	261	297	261
10	2881	209	288	209
11	3045	163	277	163
12	3164	119	264	119
13	3271	107	252	107
14	3351	80	239	80
15	3421	70	228	70
16	3473	52	217	52
17	3515	42	207	42
18	3549	34	198	34
19	3576	27	188	27
20	3597	21	180	21
21	3614	17	172	17
22	3624	10	165	10
23	3628	4	158	4
24	3628	0	151	0

Figure 3.1: Representation of a Single Factor Production Function



the other factors will result in additional output to decline beyond some point".

This law indicates an important relationship since it is that where a farmer would like to operate rationally. For example, if the farmer is producing in the first area where the marginal product increases, then he can increase the average productivity by applying more of the input; and thus, he has a strong incentive to use more units of his input to get out of this range. Similarly, application of, for example, 24th dose does not add any thing to the total output and thus, does not make any sense to apply that dose. Moreover, application of further doses may cause the total output to decrease. So the farmer keeps himself away from that range. This implies that the most relevant part of production is that range which shows a declining marginal productivity.

If the 'law of diminishing returns' had not been operative, then it would have been possible to fulfill all the milk consumption requirements of the whole world's population from one cow by only increasing her feed intake.

Average and Marginal Products and Their Relationships

Total output curve can be drawn from different levels of the variable input and the total product as in Figure 3.1. From the total product curve, one can determine two important physical productivity relationships. These are termed as average product (AP) and marginal product (MP).

The average product or average productivity is defined as the ratio of total product to the total factor input; that is, Y/X_1, where Y is total output of milk, and X_1 is the total factor input (doses of ration). In Table 3.1, average product is given in

column 4, which is obtained by dividing the total output in column 2 by the doses of input in column 1. This is represented graphically in Figure 3.2, where the input X_1 appears on the horizontal axis and the amount of average and marginal products are shown on vertical axis.

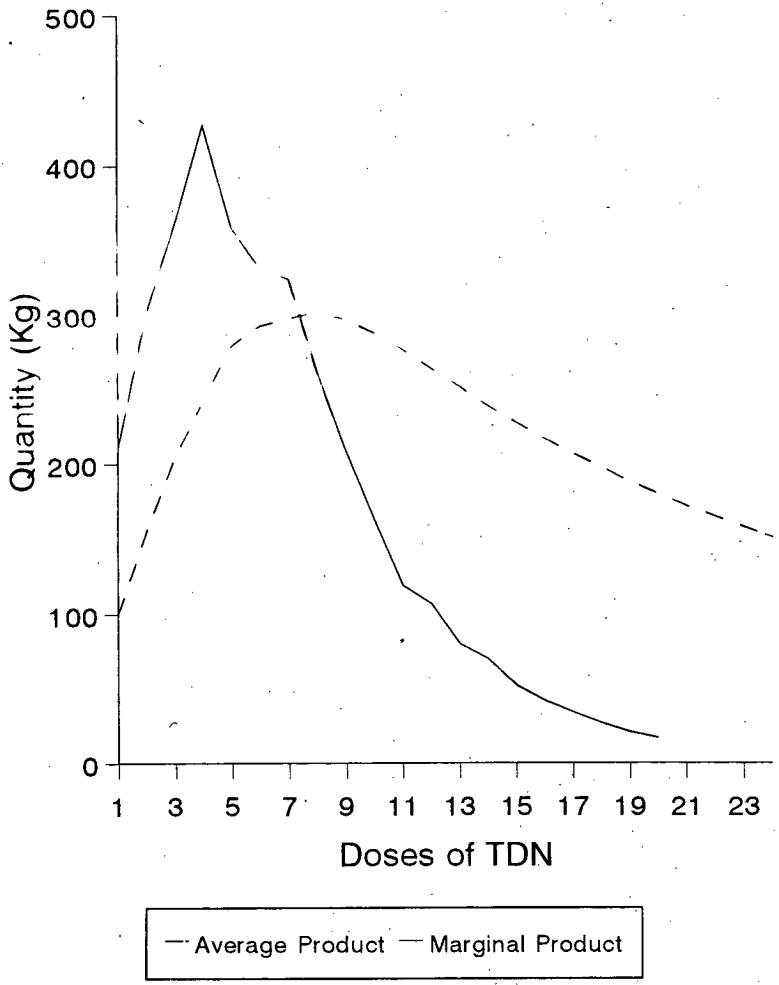
The slope of the total product curve, i.e., $\Delta Y/\Delta X_1$, indicates the marginal product and it depicts the change in output due to unit change in input. At a particular point on the total product curve, marginal product can be determined by estimating the slope of the curve at that point. A careful inspection of Table 3.1 and also Figures 3.1 and 3.2 shows that the following relationships exist between the total and marginal products:

1) when the total product is increasing, marginal product is positive;
2) when the total product is maximum, marginal product is zero;
3) when the total product is decreasing, marginal product is negative;
4) when the total product is increasing at increasing rate, the marginal product is increasing; and
5) when the total product is increasing at decreasing rate, the marginal product is decreasing but positive.

The relationships between marginal and average products are also shown in Figure 3.2 that can be delineated as:

1) when the marginal product is greater than the average product, average product is increasing;
2) when the marginal product is less than the average product, average product is decreasing; and

Figure 3.2: A Graphical Representation of MP and AP.



3) when the marginal product is equal to average product, the average product is maximum.

Three Stages of Production

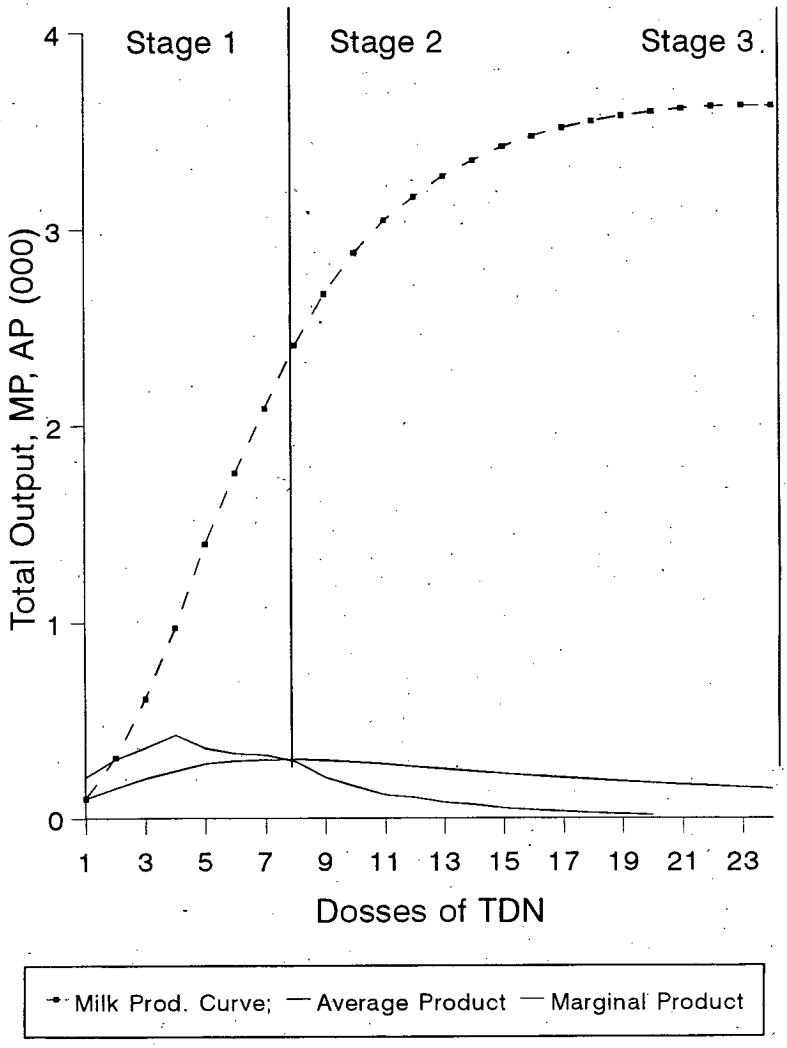
The classical production function can be divided into three segments known as stages, regions or zones. The production function is divided into these regions in order to identify a rational region where the production is most profitable (see Figure 3.3.

Region 1 of a production function goes to the level of input for which average product is maximum and that level in the present case is 8th dose of the ration. In this region average productivity of the additional units of the variable input increases progressively; marginal product in this stage of production is greater than the average product. Hence it is always profitable for the producer to continue to add inputs as long as the average productivity increases. A rational producer can always produce more product by using less of the fixed factor with the variable factors within this region. This stage is said to be irrational since greater output can be produced from the same fixed resources. Thus, in this stage the fixed factors remain underutilized.

The third region would start after the 24th dose, if used. In the third region of the production function, total product decreases. The marginal product becomes negative. In our example this stage is not shown. However, if a cow is forced to eat beyond her capacity, then she can fall sick and the total yield would decline. Thus, region III is irrational since the output can be increased by employing less of the variable factor. The fixed factors in this region are overutilized.

Region II is known as the rational region of production. In this region total product is increasing at decreasing rate; both

Figure 3.3: Three Stages of Production



marginal and average products are positive, but decreasing. Marginal product is less than the average product. The same or high level of output cannot be obtained by decreasing either the fixed or variable input. A rational producer must operate in this region in order to maximize profit. However, the most profitable level of input to use and the output to be produced in this region cannot be determined from the physical production data. It needs information about the prices of the input and the output in addition to the physical production data.

Profit Maximization With a Single Variable Input

To determine the most profitable level of a variable input, we need a) the rate of transformation of input to output, that is, production function, and b) the factor-product price ratio or choice indicator.

The optimum level of a variable input is where the added cost equals the added revenue. If Y stands for the physical output, X for the physical input, ΔY and ΔX_1 stand for change in Y and change in X_1, respectively. Let P_y denote the price of the product Y, P_{x1} denote the price of the input X_1. Then the equi-marginal principle states that a producer should continue to use additional units of a variable factor as long as the added revenue is greater than the added cost. The optimum level of the variable input is reached where the added revenue equals added cost. Symbolically, this principle of profit maximization can be expressed in various ways, and this phenomenon is explained below and is given in Table 3.2.

Table 3.2 **Profit Maximization in the Case of Single Input**

No. of Combination (X_1)	Milk Prod /Kgs (Y)	MP= $\frac{\Delta Y}{\Delta X_1}$	Method 1 & 2 $\frac{VMP=P_X}{VMP \quad P_X}$		Method 3 $\frac{}{P_x/MP \quad P_Y}$		Method 4 $\frac{}{MP \quad P_x/P_y}$		Method 5		
									Revenue	Cost	Profit
1	100	---	-----	800	----	10	---	80	1000	800	200
2	310	210	2100	800	3.81	10	210	80	3100	1600	1500
3	611	301	3010	800	2.66	10	301	80	6110	2400	3700
4	972	361	3610	800	2.22	10	361	80	9720	3200	6520
5	1399	427	4270	800	1.87	10	427	80	13990	4000	9990
6	1757	358	3580	800	2.23	10	358	80	17570	4800	12770
7	2088	331	3310	800	2.42	10	331	80	20880	5600	15280
8	2412	324	3240	800	2.47	10	324	80	24120	6400	17720
9	2673	261	2610	800	3.07	10	261	80	26730	7200	19530
10	2882	209	2090	800	3.83	10	209	80	28820	8000	20820
11	3045	163	1630	800	4.91	10	163	80	30450	8800	21650
12	3164	119	1190	800	6.72	10	119	80	31640	9600	22040
13	3271	107	1070	800	7.48	10	107	80	32710	10400	22310
14	3351	80	800	800	10	10	80	80	33510	11200	22310
15	3421	70	700	800	11.4	10	70	80	34210	12000	22210
16	3437	52	520	800	15.4	10	52	80	34730	12800	21930
17	3515	42	420	800	19	10	42	80	35150	13600	21550
18	3549	34	340	800	23.5	10	34	80	35490	14400	21090
19	3576	27	270	800	29.6	10	27	80	35760	15200	20560
20	3597	21	210	800	38.1	10	21	80	35970	16000	19970
21	3614	17	170	800	47.1	10	17	80	36140	16800	19340
22	3624	10	100	800	80	10	10	80	36240	17600	18640
23	3628	4	40	800	200	10	4	80	36280	18400	17880
24	3628	0	0	800	----	10	0	80	36280	19200	17080

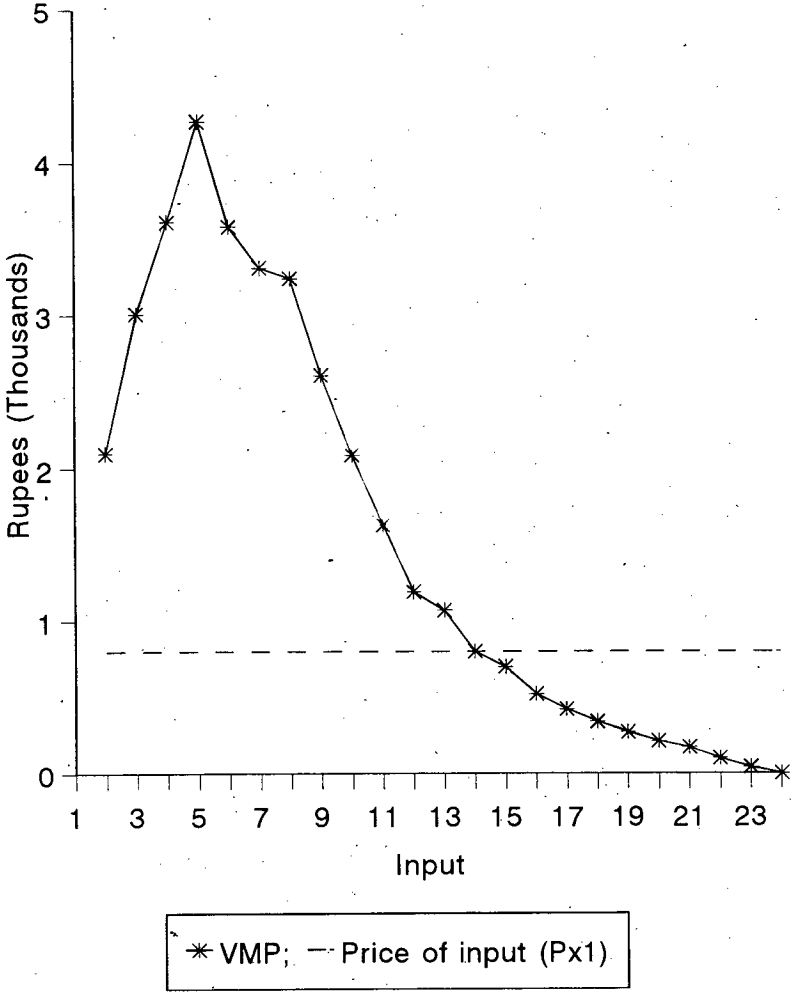
Price of X (P_x = Rs.800/unit)
Price of Y (P_y = Rs.10 /unit)

i) Added revenue equals added cost, $\Delta Y\ P_Y = \Delta X_1\ P_{X_1}$. If $\Delta Y\ P_Y > \Delta X_1\ P_{X_1}$ use more of X to maximize profit, and use less of X when $\Delta Y\ P_Y < \Delta X_1\ P_{X_1}$.

ii) Given $\Delta Y\ P_Y = \Delta X_1\ P_{X_1}$ and dividing ΔX_1 on both sides, we get $\frac{\Delta Y}{\Delta X_1}\ P_Y = P_{X_1}$ or $MP_{X_1} = P_{X_1}/P_y$ or $MP_{X_1}\ P_Y = P_{X_1}$ or $VMP_{X_1} = P_{X_1}$. This condition states that profit of the producer is maximum where the value of marginal product is equal to the price of the input, where the value of marginal product may be defined as the addition made to total revenue with the application of an additional unit of the variable input. If $VMP_{X_1} > P_{X_1}$ then use more of X,and if $VMP_{X_1} < P_{X_1}$ then use less of X to maximize profit (see Figure 3.4).

iii) Given $\Delta Y\ P_Y = \Delta X_1\ P_{X_1}$ and dividing ΔY on both sides, we get $P_Y = \frac{\Delta X_1\ P_{X_1}}{\Delta Y}$ or $P_Y = \frac{P_{X_1}}{MP_{X_1}}$ (marginal revenue = marginal cost). This states that price of output equals the cost of additional output using an additional unit of input. This situation expresses that profit is maximum where the marginal revenue or price of output is equal to the marginal cost. This implies that if $P_Y > \frac{P_{X_1}}{MP_{X_1}}$ use more of

Figure 3.4: A Graphical Representation of Method 2 of Profit Maximization.



X_1 and if $P_Y < \frac{P_{X_1}}{MP_{X_1}}$ use less of X_1 to maximize profit (see Figure 3.5).

iv) Given $\Delta Y \; P_Y = \Delta X_1 \; P_{X_1}$ and by rearranging it we get $\frac{\Delta Y}{\Delta X_1} = \frac{P_{X_1}}{P_Y}$ (marginal product = inverse price ratio). This states that profit of the producer is maximum where the marginal product is equal to the price ratio. Here the principle for profit maximization is; if $\frac{\Delta Y}{\Delta X_1} > \frac{P_{X_1}}{P_Y}$ then use more of X_1; and if $\frac{\Delta Y}{\Delta X_1} < \frac{P_{X_1}}{P_Y}$, then use less of X_1 to maximize profit (see Figure 3.6).

v) Another way of stating the principle is that add input until the difference between the total revenue ($Y \; P_y$) and the total cost ($X_1 \; P_{X1}$) is maximum (see Figure 3.7).

Application of the above methods to the data presented in Table 3.2 shows that the producer is maximizing his profit with 14 units of ration input. With the use of method (v), Figure 3.7 and also Table 3.2 show that the producer could earn Rs. 22310.33 with either 13th or 14th unit of input. It may be pointed out that we are using the average marginal product concept in output calculations. If the use of input units in fractions were possible, it could then be shown that the profit maximizing level of input would lie between 13 and 14 units of the input.

Figure 3.5: A Graphical Representation of Method 3 of Profit Maximization.

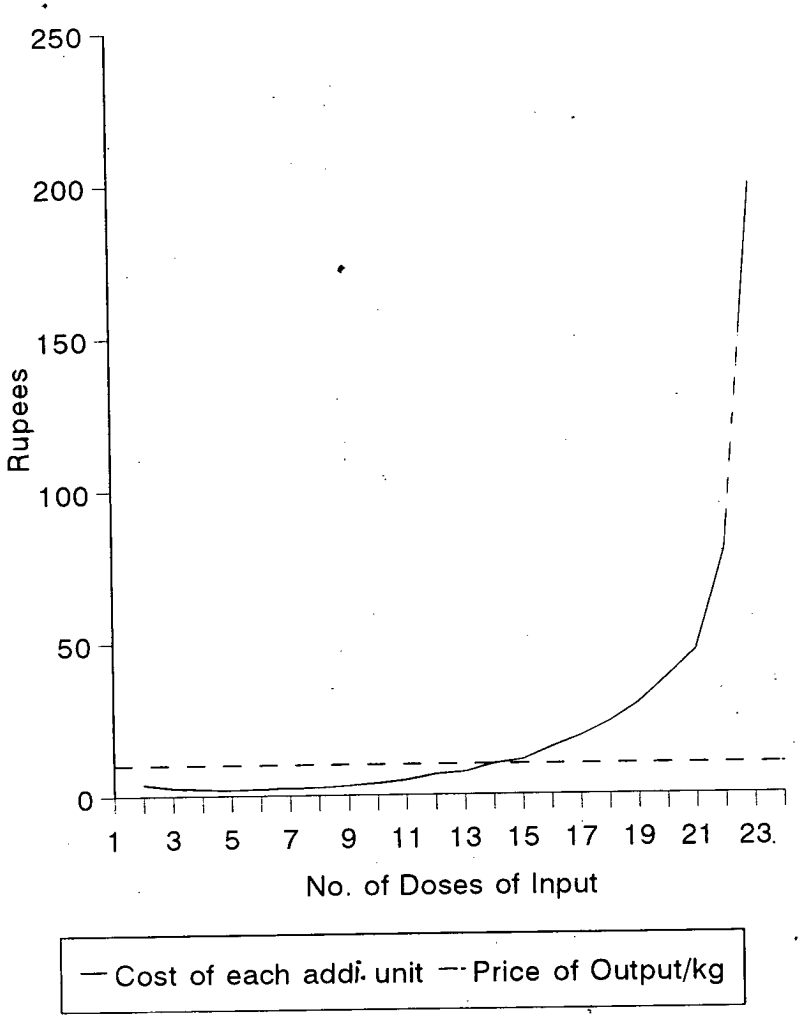


Figure 3.6: A Graphical Representation of Method 4 of Profit Maximization.

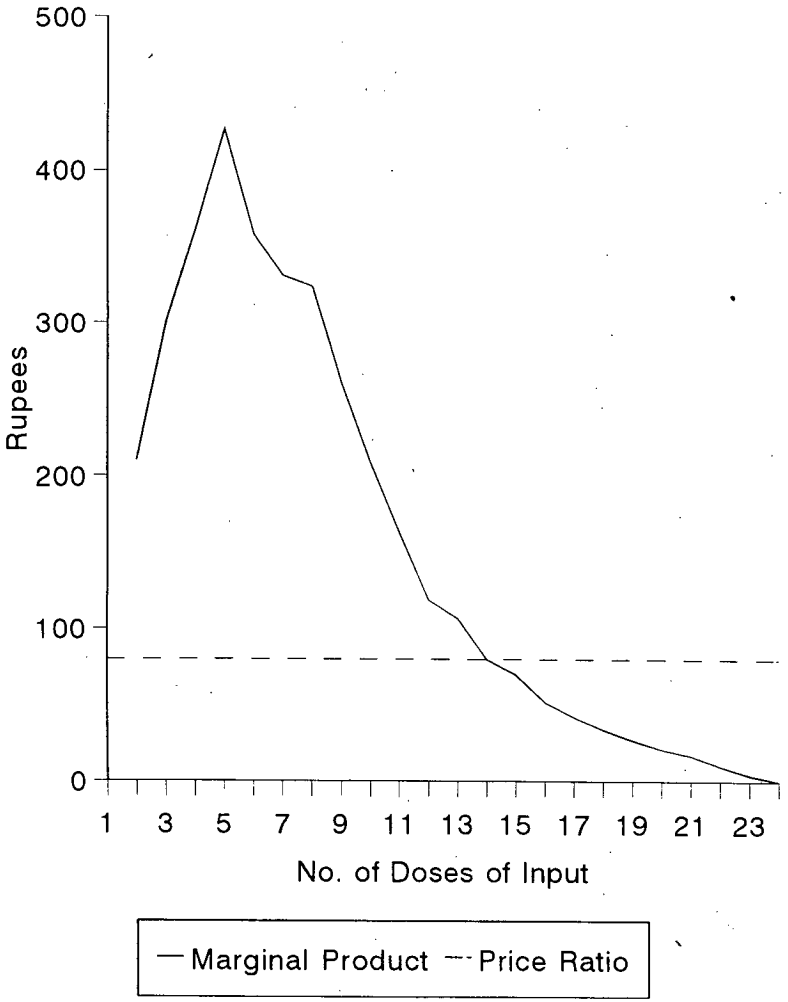
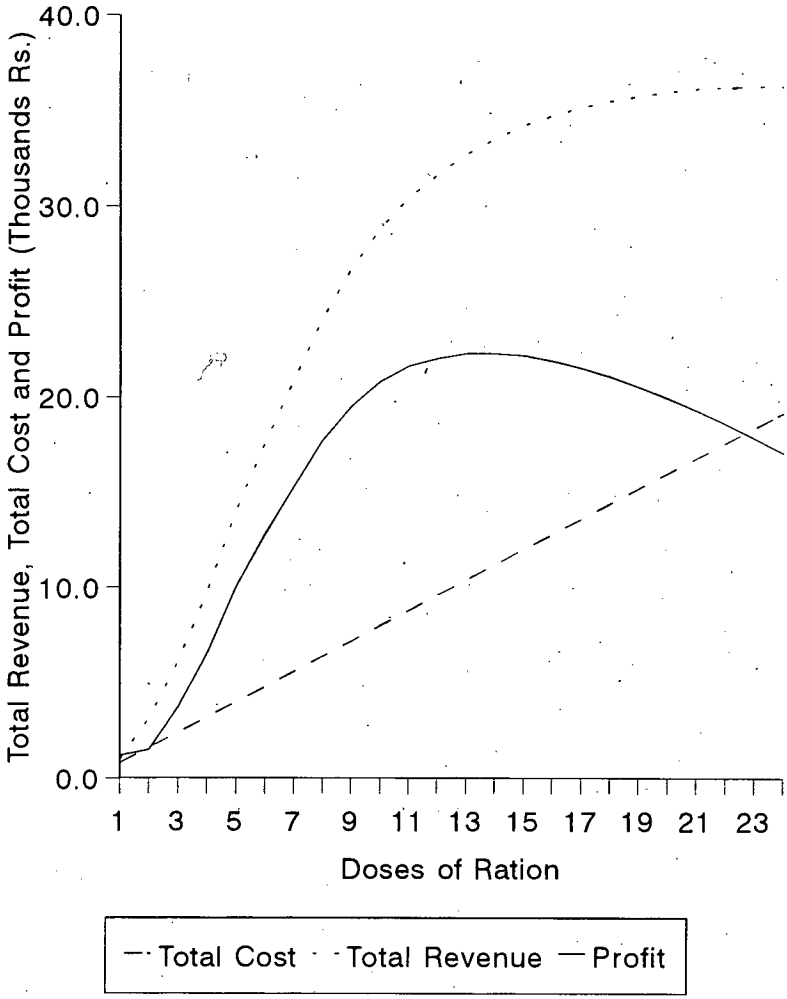


Fig.3.7: A Graphical Representation of Profit Maximization Using Method 5.



Of the various methods discussed above, the marginal value product concept is of particular importance to the economists because in case where there is a single variable factor then the marginal value product of the factor is also the demand curve for the factor.

FACTOR - FACTOR RELATIONSHIP

In the previous case, production decisions were confined to the situation where there was only one variable input factor. Production problems generally involve situations where two or more inputs or variables are employed. Let us consider a situation where only two inputs are used in production and the function can be written as

$$4. \qquad Y = f\ (X_1,\ X_2/X_3, \ldots, X_n),$$

where Y is output, while X_1 and X_2 are quantities of concentrates and green fodder (berseem). It is to be noted that these inputs are fed to livestock along with the other inputs which are kept constant at a fixed level.

Our concern here is that what would happen to output when the quantities of inputs X_1 and X_2 are increased or decreased. Besides the effect on output, what would happen to substitution of one variable factor for another by changing the quantities of these inputs. Thus, we would be focusing now on the substitution between X_1 and X_2 in any livestock production process. The farmer could choose various combinations of the factors of production within the limitations of his investment capacity. The economically feasible level of output from different combinations of given level of inputs hinges on how the variable inputs are

combined. Thus, the critical feature of studying factor-factor relationship is to determine the possibilities of mixing and substituting two or more factors in the production of a given level of output that is economically feasible.

Iso-Product Curve

Iso-product or Iso-quant is a curve that represents different efficient combinations of X_1 and X_2 that are capable of producing a given level of output. Farmers are always interested in finding out the least cost or cheapest method to produce a given level of output. Sometimes different input combinations can be used to produce a particular level of output. It is possible that a cheapest way exists to produce a product using only one factor and none of the other, but in other cases it might be the case that combination of two inputs is the cheapest method to produce a product. The shape of the iso-product curve depends on the way by which the variable inputs are combined in production.

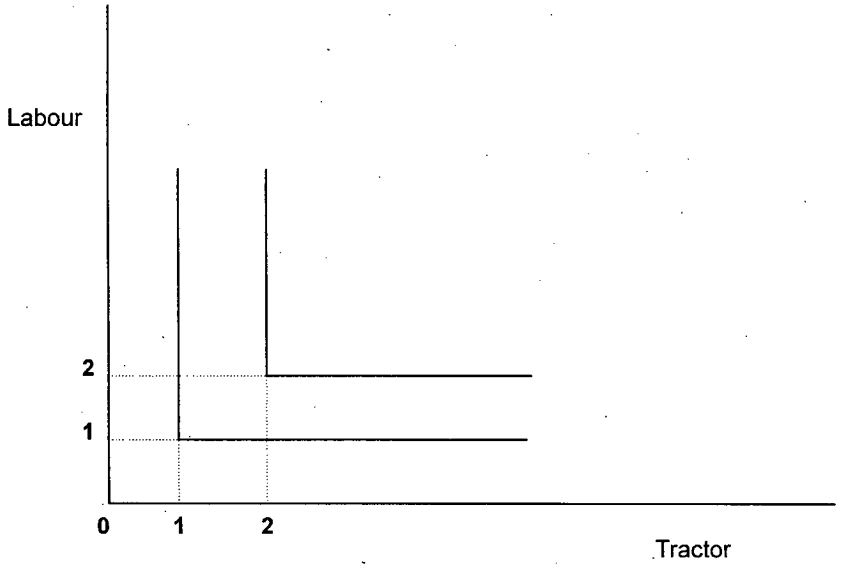
Fixed Proportion

The iso-product curve shown in Figure 3.8 represents that the inputs are combined in fixed proportion in the production of a commodity. For example, neither a tractor nor a pair of bullock (X_1) can be operated without the labour input (X_2).

Constant Rate of Substitution

In this case the iso-product curve is a straight line, which indicate that the marginal rate of technical substitution is constant on any point on the curve; meaning that it is same whatever the relative amounts of factors X_1 and X_2 are being used. The

Figure 3.8: A Graphiclal Representation of fixed Proportion Isoquants



marginal rate of substitution may be defined as the number of units by which the usage of one input (X_2) must be decreased when the usage of the other input (X_1) is increased by one unit along an iso-quant, i.e., when the output is at a particular level. The marginal rate of technical substitution may be written as $\frac{\Delta X_2}{\Delta X_1}$, which is negative of the slope of the iso-quant, and this slope remains constant throughout the line (iso-quant).

Consider a case where a farmer prepares his own feed. He thinks that the major source of energy is either maize or sorghum, and finds that 1.90 kg of maize (X_1) supplies the same energy as 2 kg of sorghum (X_2). Assume that required amount of energy is represented by the product line, and that this energy can be supplied by 200 kgs of sorghum or 190 kg of maize. The same amount of energy can also be obtained by using different combinations of sorghum and maize (see Table 3.3). Figure 3.9 shows that the iso-quant is a straight line, and thus, its slope $\Delta X_2 / \Delta X_1$, which is the marginal rate of technical substitution, is constant on all the points of the curve.

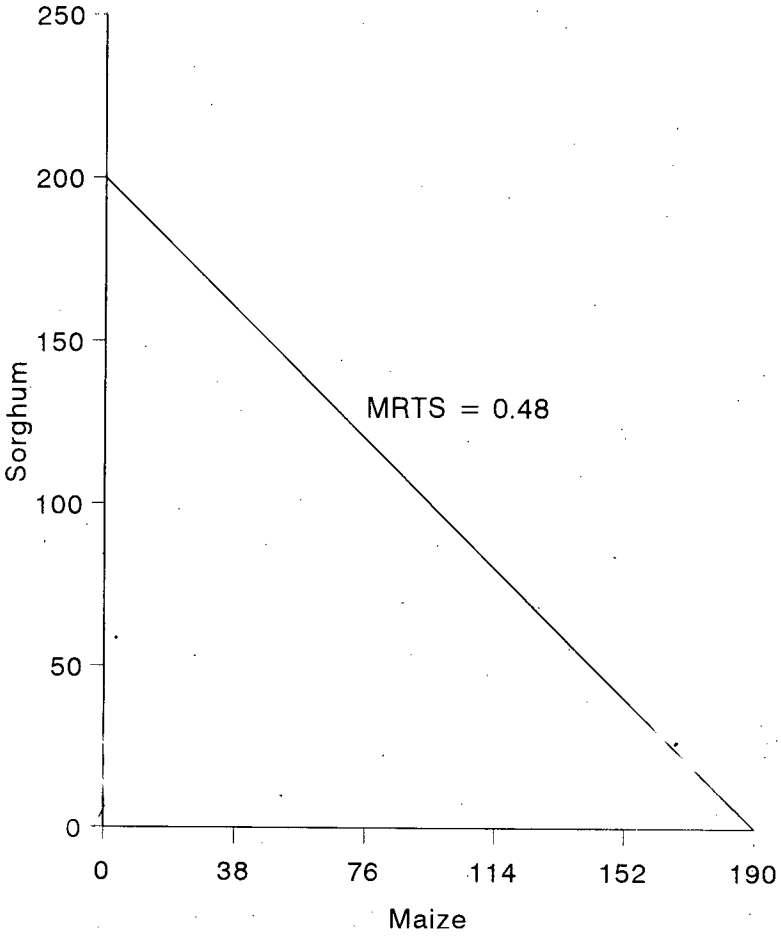
Diminishing Rate of Substitution

In this case, each unit increase in X_1 replaces less and less of X_2 in the production of a given level of output. The slope of the iso-quant becomes smaller as more of X_1 is used relative to X_2. The phenomenon of decreasing rate of substitution can easily be explained using the law of diminishing marginal productivity. As the use of X_1 increases, its marginal product tends to decrease. On the other hand the use of X_2 decreases and, thus, its marginal product increases. Since the marginal rate of substitution equals the marginal product of X_2 (which is

Table 3.3: Constant Rate of Substitution

Sorghum (X_1)	Maize (X_2)	Change in X1 & X2		MRTS
		ΔX_1	ΔX_2	$\Delta X_2/\Delta X_1$
200	0	-	-	0.48
160	38	40	19	0.48
120	76	40	19	0.48
80	114	40	19	0.48
40	152	40	19	0.48
0	190	40	19	0.48

Figure 3.9: An Isoquant Representing Constant Rate of Substitution



declining) divided by Marginal product of X_1 (which is increasing), it must be diminishing as X_1 is substituted for X_2. Declining marginal rate of substitution as X_1 increases and X_2 decreases, implies that the iso-product curve is convex to the origin.

Consider an example of cotton seed and berseem inputs, which substitute each other for the production of milk in such a manner that leads to diminishing marginal rate of substitution. It is assumed here that 10 kgs of milk can be obtained with different combinations of cotton seed (X_2) and berseem (X_1). These combinations are 13.55 kgs of X_2 and 1 kg of X_1 or 5.22 kgs of X_2 and 6 kgs of X_1 or 2.74 kgs of X_2 and 11 kgs of X_1 or 1.77 kgs of X_2 and 16 kgs of X_1 or 1.24 kgs of X_2 and 21 kgs of X_1 or 0.90 kgs of X_2 and 28 kgs of X_1. This particular example indicates that X_1 and X_2 are substitutable and the column 4 of Table 3.4 clearly indicates that the MRTS declines as X_2 is substituted for X_1. This has also been presented in Figure 3.10, where the iso-product is negatively sloped and convex to the origin.

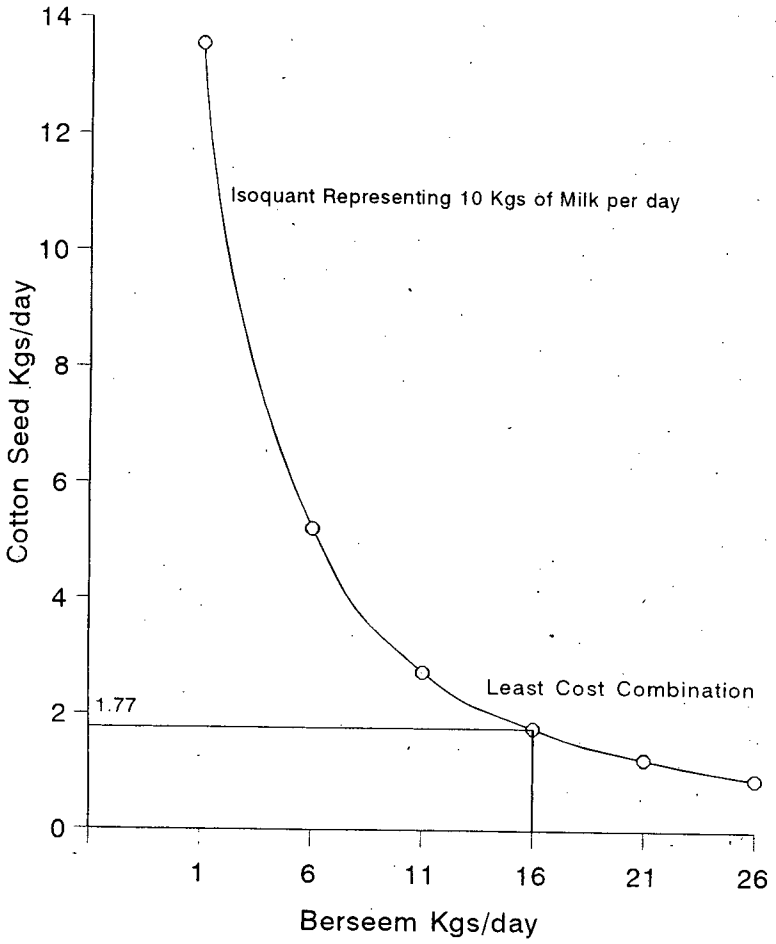
Least Cost Combination of Inputs

To determine the least cost combination of inputs, we need 1) the rate at which the inputs can be exchanged in production, i.e., the marginal rate of technical substitution (MRTS) $\frac{\Delta X_2}{\Delta X_1}$ and 2) the rate at which the inputs can be exchanged in the market, i.e., the ratio of the prices of the two inputs $[\frac{PX_1}{PX_2}]$ where PX_1 is the price of X_1 and PX_2 is the price of X_2.

Table 3.4 **Determination of Least Cost Input Combination**

1	2	3		4	5	6	7	8	9	10
(X_1) Berseem (kgs)	(X_2) Cotton seed (kgs)	Change in X_1 and X_2 ΔX_1	ΔX_2	MRTS $\frac{\Delta X_2}{\Delta X_1}$	$\frac{P_{X1}}{P_{X2}}$	$\Delta X_1 P_{X1}$	$\Delta X_2 . P_{X2}$	$P_{X1} . X_1$	$P_{X2} . X_2$	Total Cost 8+9
1	13.55	-	-	-	-	-	-	0.80	34.44	34.94
6	5.22	5	8.13	1.63	0.19	2.50	20.98	3.00	13.47	16.47
11	2.74	5	2.48	0.50	0.19	2.50	6.40	5.50	7.07	12.57
16	1.77	5	0.97	0.19	0.19	2.50	2.50	8.00	4.57	12.07
21	1.24	5	0.53	0.11	0.19	2.50	1.37	11.50	3.20	13.70
26	0.90	5	0.34	0.07	0.19	2.50	0.88	13.00	2.32	15.32

Figure 3.10: An Isoquant Representing 10 Kgs. of Milk/day.



The combination of inputs that minimizes the cost of given quantity of output is attained when the marginal rate of technical substitution (MRTS) is equal to the inverse factor price ratio, i.e., $\frac{\Delta X_2}{\Delta X_1} = \frac{P_{X_1}}{P_{X_2}}$. This condition is met when the slope of the iso-quant, $\frac{\Delta X_2}{\Delta X_1}$, is equal to the slope of iso-cost line, $\frac{PX^{\gamma}}{PX_2}$. *If* $\frac{\Delta X_2}{\Delta X_1} > \frac{PX_1}{PX_2}$[40] then cost can be reduced by decreasing the use of X_2 and increasing the use of X_1. If $\frac{\Delta X_2}{\Delta X_1} < \frac{PX_1}{PX_2}$, then cost can be reduced by increasing the use of X_2 and decreasing the use of X_1

The least cost combination can also be given as $\Delta X_1 \; P_{X_1} = \Delta X_2 \; P_{X_2}$ It states that the cost of adding X_1 is equal to the reduction in cost from using less of X_2. If $\Delta X_1 PX_1 > \Delta X_2 PX_2$, then an increase in the use of X_2 and a decrease in the use of X_1 will reduce cost. If $\Delta X_1 PX_1 < \Delta X_2 PX_2$, then more use of X_1 and less use of X_2 will decrease cost. If Px_1 =Rs 2.58/kg and Px_2 =Rs 0.5/kg, milk is produced with lowest possible cost using 1.77 kgs of X_1 and 16 kgs of X_2 (Figure 3.10 and Table 3.4).

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40 [1]Iso-cost line represents all possible combinations of two inputs, which can be purchased at a give level of resource income.

PRODUCT-PRODUCT RELATIONSHIP

Product-product relationship is concerned with the allocation of a fixed resource set between competing enterprises. The farmer has to take great care in selecting the most appropriate product or product mix to maximize his profit from the given resource set. The selection of products is very much influenced by the relationship that exists between the particular products under consideration. The relationship between products can be categorized as competitive, supplementary, complementary, or joint products. To explain these categories we will make use of production possibility curve, which represents various possible combinations of two products that can be produced with fixed level of inputs. This curve is also called the production frontier, since all the combinations on this curve show the maximum attainable output for a given level of input. The slope of the production possibility curve denotes the rate at which one product substitutes for another.

Competitive Products

Two products are competitive in the use of given resources if an increase in the output of one product involves a reduction in the output of the other product. The marginal rate of product substitution, which indicates the quantity of one product that must be given up when the output of the other product is increased by one unit, is negative. Marginal rate of product substitution can be denoted as $\frac{\Delta Y_2}{\Delta Y_1}$. It indicates the number of units of Y_2 which must be given up when an additional unit of

Y_1 is to be produced. If the two products are competitive, the marginal rate of product substitution, $\frac{\Delta Y_2}{\Delta Y_1}$, is negative.

The nature of product relationships depends on the nature of production function for each independent product. These could be 1) the constant rate of substitution; 2) decreasing rate of substitution; or 3) increasing rate of substitution.

1. *Constant Rate*. When the two products substitute for each other at a constant rate, the marginal rate of product substitution remains constant over the range of possible product combinations. Two breeds of lamb or of milk cows substitute at constant rates when competing for a given area of range land. Production possibility curve of this type is represented in Figure 3.11, of which the slope $\Delta Y_2/\Delta Y_1$ is constant throughout the curve. When two products substitute at a constant rate, only one of the products should be produced to maximize net revenue. For example, that breed of lamb or cow should be kept on the farm which gives higher return.
2. *Decreasing Rate*. When the two products substitute at diminishing rate, decreasing quantities of one product must be sacrificed to get an additional unit of the other product. The production possibility curve is convex to the origin. An example of this type of relationship is provided in Figure 3.12. Product combinations showing diminishing rate of substitution are not common in agriculture. These may be found on farms where the farmers are operating in stage I of the production function, since the amount of resource being used is so small that the production of both the products is taking place in the region of increasing

Figure 3.11: Constant Rate of Product Substitution

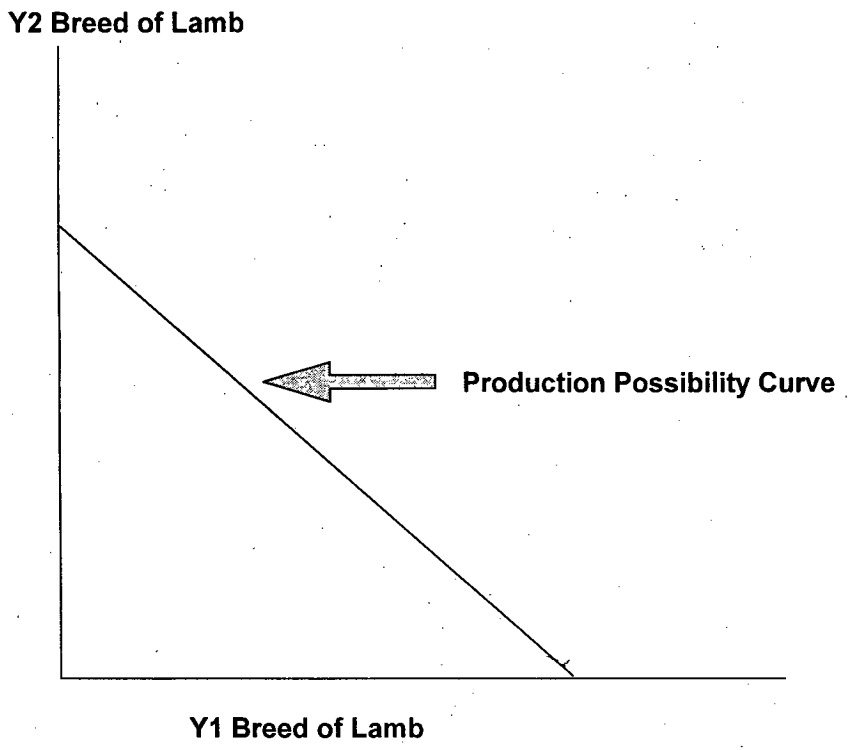
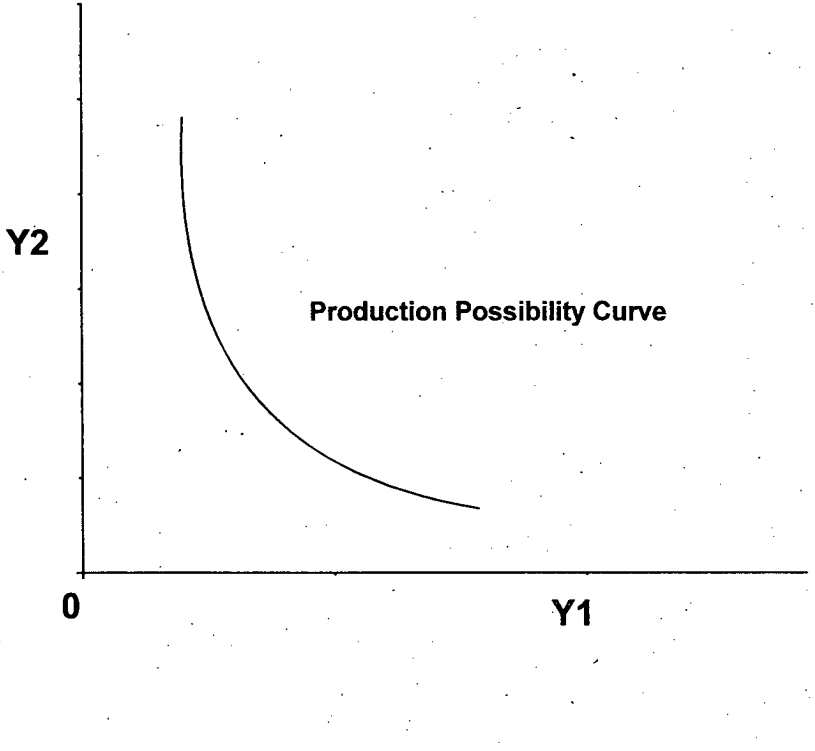


Figure 3.12: Production Possibility Curve Showing Decreasing Rate of Product Substitution



returns. As it has been discussed previously that the rational producer will never produce in this region. A combination of such two products does not yield maximum net revenue. Thus, the producer might have to increase the resource base or to opt for one enterprise.

3. *Increasing Rate*. When two products substitute at increasing rate, increasing quantities of one product must be given up to get an additional unit of the other product. The production possibility curve is concave to the origin. An example of this type of relationship is provided in Table 3.5 and Figure 3.13. This type of relationship is quite common in agriculture. Increasing rate of substitution hold true when both the products are produced in the second region of the production function, i.e., marginal products are positive but diminishing.

Supplementary Products

Two products are supplementary when an increase in output of one product, holding the resources constant in quantity, has no effect on the level of output of the second product. In other words, with the same resources, the output of one product can be increased with neither a gain nor a sacrifice in the other product. Supplementary products use the idle resources. On small farms keeping a few milk animals or poultry birds may be supplementary to the crop enterprises because permanent labour is used to produce these products without reducing the productivity of the crop products. Such a relationship is depicted in Figure 3.14. The portions AB and DC of the curve show that Y_1 and Y_2 are supplementary to each other. However, if the production of Y_2 (or Y_1)is increased further it will compete for

Table 3.5 **Possible Product Combinations of Y1 and Y2 under increasing rates of substitution**

Beef(Y_1) (Kgs.)	Mutton (Y_2) (Kgs.)	ΔY_1	ΔY_2	MRPS $\Delta Y_2 / \Delta Y_1$
0	1000	-----	------	------
200	985	200	15	0.08
400	965	200	20	0.10
600	930	200	35	0.18
800	885	200	45	0.23
1000	840	200	45	0.23
1200	770	200	70	0.35
1400	690	200	80	0.40
1600	560	200	130	0.65
1800	365	200	195	0.98
2000	0	200	365	1.83

Figure 3.13: Production Possibility Curve Showing Increasing Rate of Substitution.

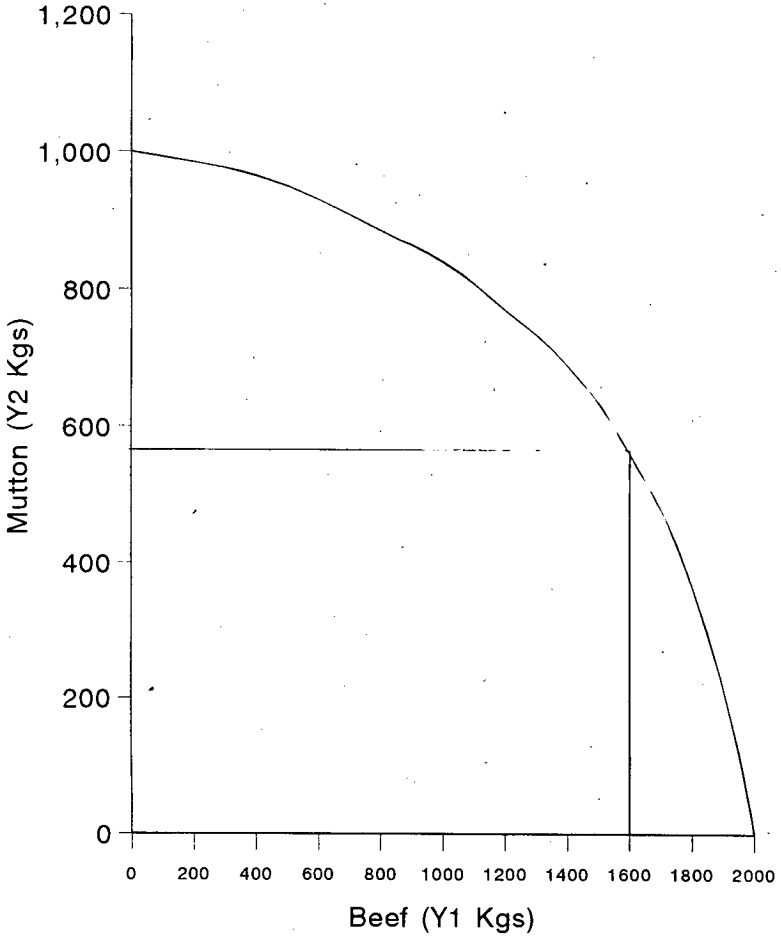
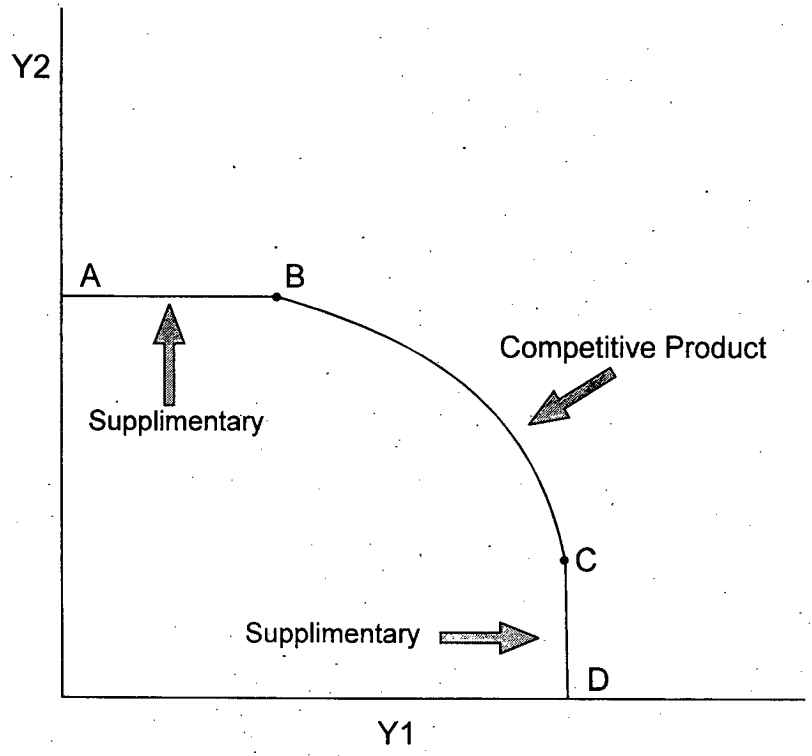


Figure 3.14: Supplimentary Relationship



the fixed labor resource. Thus, it would be necessary to reduce the output of Y_1 (Y_2) to increase the production of Y_2 (Y_1)

Complementary Products

Two products are complementary when an increase in output of one product, using the fixed resources, also increases the output of the second product. In other words a shift of resources from one product to a second product will increase rather than decrease the output of the first. This type of relationship widely prevails in agriculture. On a mixed farm of poultry and fish, the waste of poultry can be used as feed of fish. Thus, this relationship is complementary between these two products. Such a relationship is depicted in Figure 3.15. The complementary range goes from D to C. In this area, an increase is production of Y_2 is accompanied by an increase in the production of Y_1. However, after this range this relationship will be competitive since both the products will compete for the fixed resource, say labour. However, on a large Fish farm this relationship could be supplementary by keeping few poultry birds, i.e., AB.

Joint Products

These products are obtained in fixed proportions. If a given quantity of one product is produced, the quantity of the other products is fixed by nature. Joint products are produced through a single production function and for the purpose of analysis they may be treated as single product. The combinations of products are represented in Figure 3.16. Examples of joint products are lamb and wool, eggs and chicken manure, milk and calves, and beef and hides. The relevant part of this PPC curve is the point

Figure 3.15: A Graphical Representation of Complementary Products

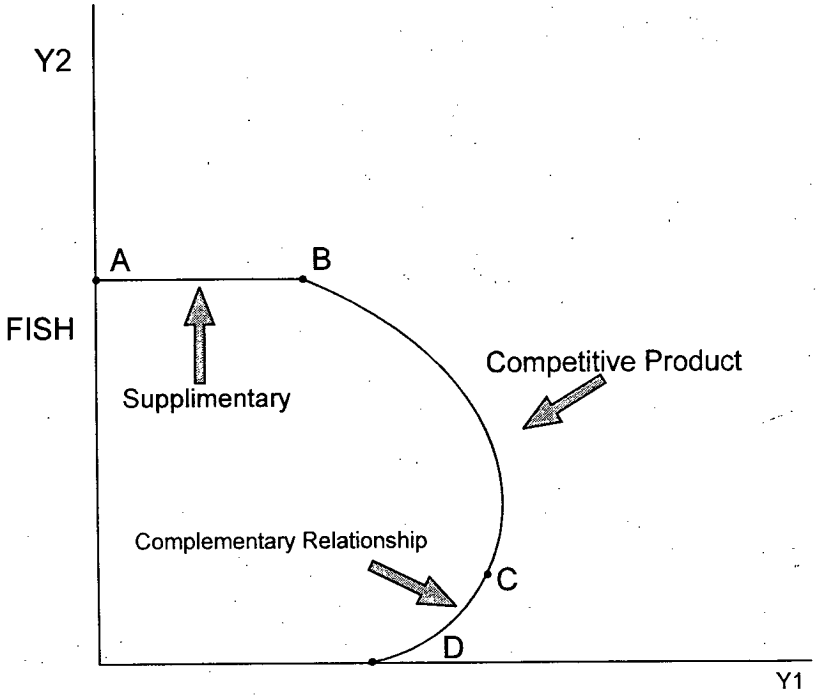
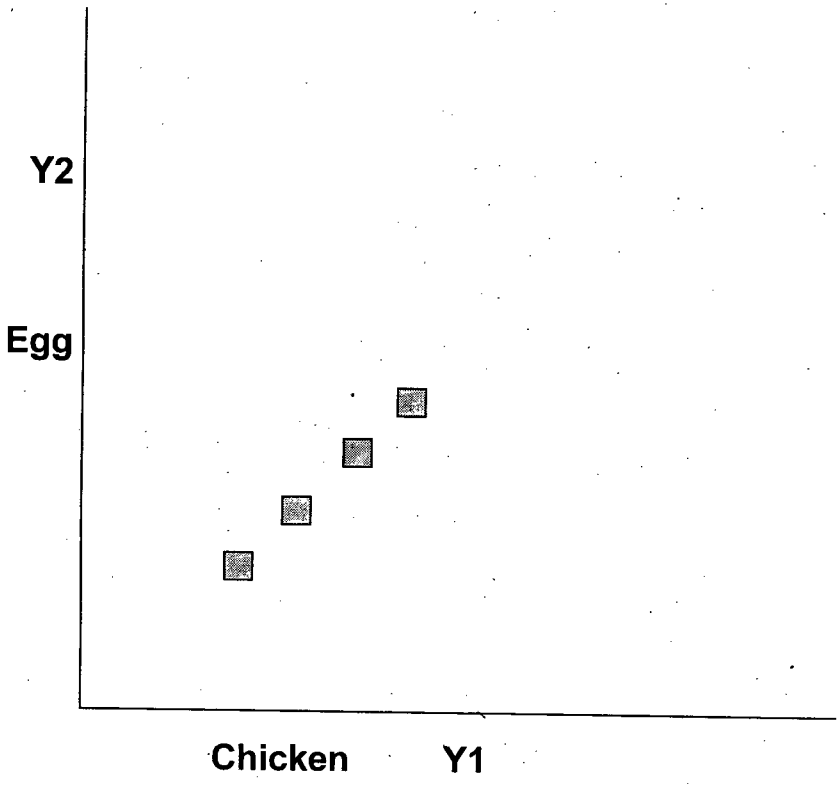


Figure 3.16: Joint products



on the corner; that is, these products are produced in fixed proportion regardless of the price situation.

OPTIMUM PRODUCT COMBINATION

The optimum product combination depends on the marginal rate of product substitution and the price ratio. The marginal rate of product combination shows the rate at which products can be substituted in the production, while the price ratio shows how the product can be exchanged in the market. Maximum net revenue is attained at a point with resources or costs fixed in quantity, where the marginal rate of product substitution is inversely equal to the product price ratio. This can be written as $\frac{\Delta Y_2}{\Delta Y_1} = \frac{P_{Y_1}}{P_{Y_2}}$, where $\Delta Y_2 / \Delta Y_1$ is marginal rate of product substitution and the P_{Y_1} / P_{Y_2} is price ratio of the two products. This can also be written as $\Delta Y_2 . P_{Y_2} = \Delta Y_1 . P_{Y_1}$, which implies that marginal revenue obtained from product Y_1 is equal to marginal revenue of product Y_2. If $\frac{\Delta Y_2}{\Delta Y_1} > \frac{P_{Y_1}}{P_{Y_2}}$ implying $(\Delta Y_2)(P_{Y_2}) > (\Delta Y_1)(P_{Y_1})$, then revenue can be increased by substituting Y_2 for Y_1 till the equality holds. On the other hand, if $\frac{\Delta Y_2}{\Delta Y_1} < \frac{P_{Y_1}}{P_{Y_2}}$ implying $(\Delta Y_2)(P_{Y_2}) < (\Delta Y_1)(P_{Y_1})$ then revenue can be increased by substituting Y_1 for Y_2 till the equality holds.

This profit maximizing procedure can intuitively be explained using the law of diminishing returns. When some units of a fixed resource are diverted from product Y_1 to product Y_2

additional physical output of Y_2 will decline and of Y_1 will increase and vice versa.

The condition mentioned above for the profit maximization or net revenue can also be illustrated graphically (using infomation given in Table 3.6. Any combination of two products Y_1 and Y_2 represented by production possibility curve can be produced with the given available resources. Any point on this curve which gives the maximum revenue will also maximize net revenue. If we assume that Py_1 = 60/kg and Py_2 = Rs 90/kg, we can draw iso-revenue lines showing all possible combinations of Y_1 and Y_2 which will generate an equal revenue.

For example, we can construct an iso-revenue line showing all possible combinations of Y_1 and Y_2 which will generate Rs 146400. This amount can be earned either by 2440 units of Y_1 (i.e., 146400/60) or 1626.67 units of Y_2 ($i.e., \frac{146400}{90}$) or by any other combination of Y_1 and Y_2.

Production at any other combination will yield total revenue less than that associated with combination mentioned above because the gain in revenue from increasing the production of one product is less than the reduction in revenue in the production of the other product (see last column of Table 3.6).

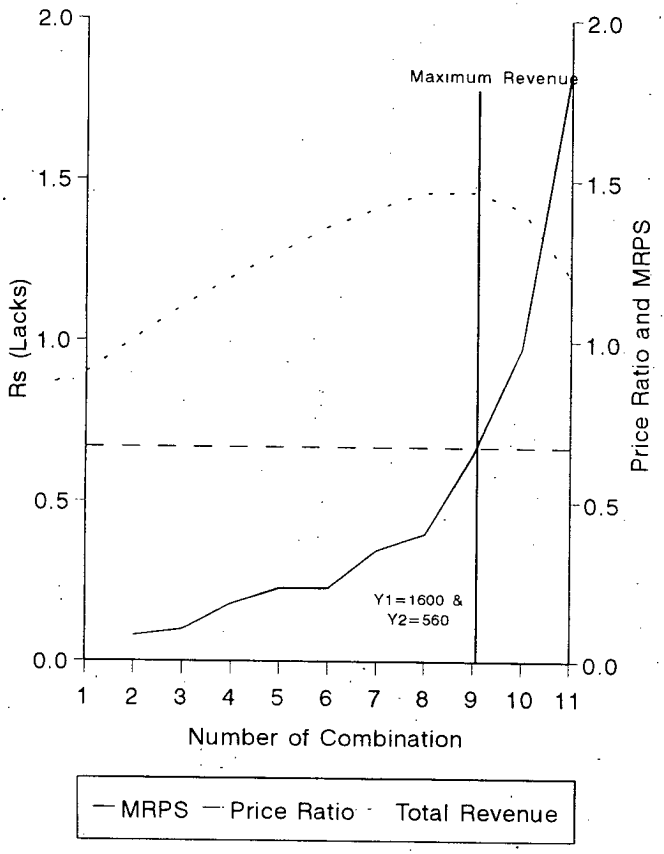
Figure 3.17 also explains the phenomenon of determining optimal combination of two outputs. This diagram has various combinations of two products on horizontal axis; while total revenue from both products, marginal rate of product substitution (MRPS) and the price ratio are on vertical axis. This figure clearly shows that where MRPS is equal to Px_1/Px_2 at 9th combination total revenue from two products is maximum. The 9th combination in Table 3.6 shows 1600 kg of beef and 560 kg of mutton production.

Table 3.6 **Determining the Optimum Combination of Two Products**

Number of Combination	Output (kgs)		Change in Y1 and Y2		MRPS = $\Delta Y_2 / \Delta Y_1$	Price Ratio = $\frac{PY_1}{PY_2}$	Additional Revenue		Total Revenue from Y_1 and Y_2
	Beef (Y_1)	Mutton (Y_2)	ΔY_1	ΔY_2			$\Delta Y_1 . PY_1$	$\Delta Y_2 . PY_2$	
1	0	1000	---	-----	------	0.67	-------	------	90000
2	200	1000	200	15	0.08	0.67	12000	1350	100650
3	400	965	200	20	0.10	0.67	12000	1800	110850
4	600	930	200	35	0.18	0.67	12000	3150	119700
5	800	885	200	45	0.23	0.67	12000	4050	127650
6	1000	840	200	45	0.23	0.67	12000	4050	135600
7	1200	770	200	70	0.35	0.67	12000	6300	141300
8	1400	690	200	80	0.40	0.67	12000	7200	146100
9	1600	560	200	130	0.65	0.67	12000	11700	146400
10	1800	365	200	195	0.98	0.67	12000	17550	140850
11	2000	0	200	365	1.83	0.67	12000	32850	120000

Note: Price of Y_1 (P_{y1} = Rs.60.00 /kg); Price of Y_2 (P_{y2} = Rs. 90.00 /kg)

Figure 3.17: A Graphical Representation of Determining the Optimum Combination of Two Products.



A producer should always take advantage of the complementary and supplementary relations and thus, produce at a point where the relationship between the products is competitive. A producer will maximize total revenue at any point in the competitive range where the marginal rate of product substitution is equal to the price ratio.

CHAPTER IV

PROFITABILITY ANALYSIS OF LIVESTOCK PRODUCTS

Farming in developing countries, including Pakistan, is not entirely a subsistence occupation. The farmers sell part of their produce and purchase some of the inputs. Consequently, the farming business is affected by the changes in prices of outputs and inputs, technology and marketing developments. The farmer has to undergo the difficult process of continuous decision-making and choosing among the alternative uses of scarce resources. In order to have maximum net profit, it is crucial for a farmer to acquire new knowledge regarding the profitability of various enterprises. The profit per unit of output from any enterprise can be derived as "Profit = Average value per unit - Average cost per unit". Such knowledge about profitability of various products is important for the farmers, planners, policy makers, administrators and other concerned individuals, who are associated with the farming sector, because of the following reasons.

1. Profitability studies help in achieving the efficient organization of farm business. The analysis of costs and returns of various farm enterprises shows the weak and strong points and thus helps in efficient farm management. It suggests to a farm manager to correct any serious mal-adjustments and effect improvements in the organization by eliminating the weaker links and substituting them with stronger ones. Cost of production studies which cover all farm

enterprises furnish very useful information on enterprise profitability and thus afford to the farmers a better choice for combining alternative farm enterprises in a manner that ensures optimum use of available resources.

2. The results of cost and profitability studies are highly useful aids in the formulation of price policies which constitute an important public policy instrument for manipulating supply and demand of various commodities. Price fixation of any commodity requires information on per unit cost of production. In the absence of such an information, any attempt at price fixation will be highly inadvisable. For instance, if the government fixes the price of commodity without reference to cost of production, it is highly likely to be either below or above the unit cost. If that is below the farmer's cost of production, they would likely curtail or cease the production either by applying less quantities of various inputs to the crops concerned and/or by substituting it by other competitive crops. If on the other hand, the price is so fixed that it is above the unit cost of production, the farmers will likely increase the production of the concerned commodity either by applying more quantities of various production inputs and/or by diverting resources from other commodities. The above two situations would either decrease or increase the supply of the concerned commodity in the market and at the same time are likely to jeopardize the production of other products. Thus, price fixation of a commodity on the basis of unit cost of production is essential for

sustaining/improving production of various agricultural commodities.

3. Cost of production studies are also important from the stand point of formulation of policies with regard to agricultural taxation, subsidization of inputs and advancement of credit.

It is a common observation that some farmers achieve far better levels of productivity and income in farming than others, under similar conditions, using more or less similar resources. What are those practices and inputs that help enhance output levels? That is the point which should be very well understood.

Yield is a major factor which determines level of profit, but it must be considered in relation to level of input use. It must also be recognized that if there is any weak link in the production chain, there would, in general, be little scope for improving the other links unless the weak link is removed. For example, if the nutrition of dairy buffaloes is basically at fault, the improvement in genetic potential will probably bring little or no extra returns. The main factors influencing the profitability of milk and lamb production are given in Figures 4.1 and 4.2, respectively.

Total lactation yields are generally of less importance to the manager than average annual yields per buffalo. The latter can be estimated by dividing the total volume of milk produced on the farm by the average number of buffaloes both in milk and dry. Buffalo numbers can be obtained from the average of twelve monthly livestock counts.

Figure 4.1: Factors influencing profitability per buffalo

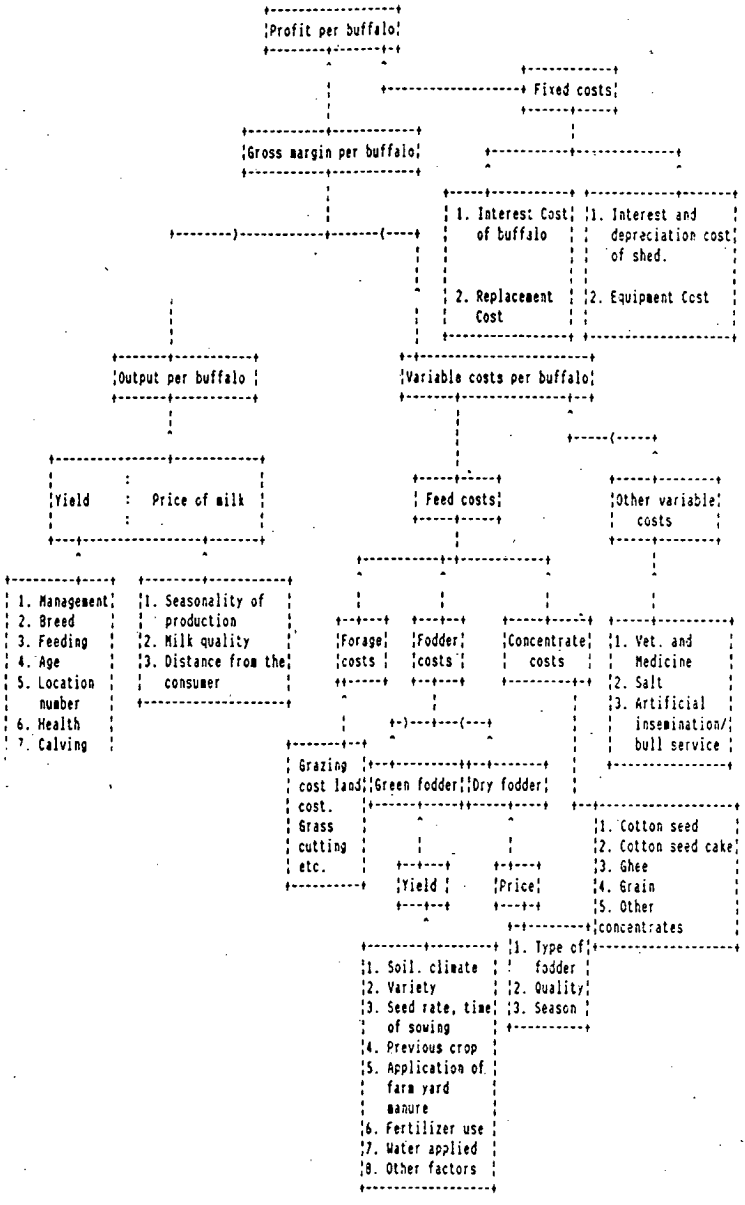
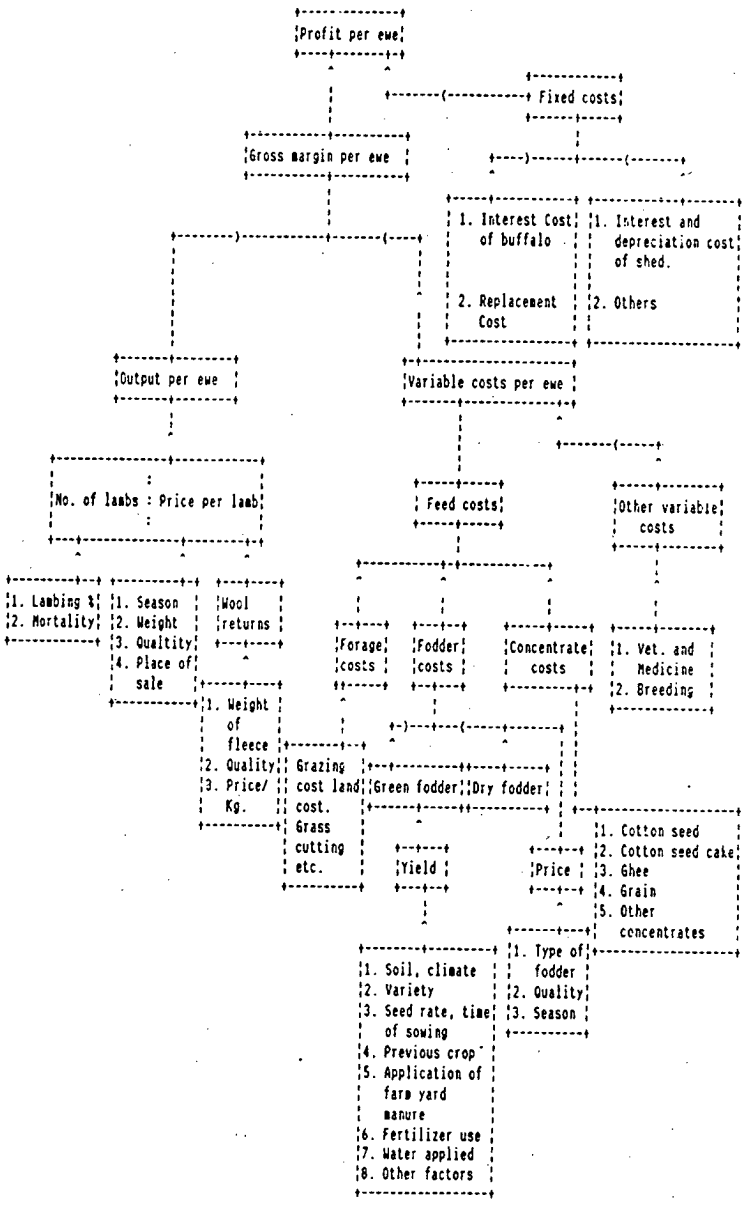


Figure 4.2: Factors influencing profitability per Sheep



Genetic potential, feeding and management are the major factors that affect milk yield. Buffaloes potential can be improved by using proven sires.

Nutrition is another factor which influences the performance of buffalo. At present the livestock in Pakistan, on the average, is significantly under-nourished. The deficit of the present availability of feed and fodder is estimated at 15-30 percent of the requirements in terms of nutrients. Management is concerned with almost all the factors that affect profitability.

Milk yield is also significantly reduced because of various diseases. Calving index or the average interval between calvings is another major factor influencing average yield per animal.

Milk price, which is an important determinant of the income/profitability, is influenced by seasonal variations (summer or winter), quality of milk sold and transportation cost.

COST AND PROFITABILITY ESTIMATION PROCEDURE

Estimation of cost of production of an enterprise (crop or livestock) is a very complex exercise. There are various fixed cost items representing about 60 percent to 70 percent of the total costs. The fixed costs are jointly shared by all the enterprises but in varying proportions and intensities. The cost of any one farm enterprise cannot be determined individually in precise terms. Therefore, costs of all the farm enterprises such as crops - wheat, cotton, sugarcane, fodder, etc., and livestock-buffaloes; cows, bullocks, etc., should be determined jointly, since all these enterprises, are interrelated on any given farm. It is very difficult to apportion fixed cost items to individual

enterprises such as milk, beef, wheat, etc. The procedure to workout all these details is explained under two main headings, i.e., labor input and capital input. Moreover, estimation of milk and beef production costs are also explained.

I. LABOUR INPUT

Labour input can be divided into three types i.e., family labour, permanent hired labour and casual hired labour.

a) Family Labour

Estimation of labour units of the family workers and their cost estimates is a very difficult task. Such labour is usually unemployed or underemployed to varying degrees. Besides sex, it falls in many age groups. To avoid any over or under estimation, family labour cost can be estimated as follows:

First of all, percent time spent on the farm for crops and livestock by each of the family members needs to be ascertained. These fractions can be converted into adult male units as follows:

Male worker age 16 to 60 years	= 1 adult unit
Male worker over 60 years	= 0.50 adult unit
Male workers between 12 & 16 years	= 0.50 adult unit

Females may be taken as 0.75 of the male in the concerned age groups given above.

The opportunity cost of family labour may be taken to be equal to the earnings of a permanent hired labour if any, or

according to the rates prevalent in the village for the permanent hired labour. A family labour unit can be a perfect substitute for a permanent hired labour unit in an effective and satisfactory manner. Therefore, a family labour unit can earn at least as much as a permanent hired labour unit earns in the village.

b) Permanent Hired Labour

Cost of permanent hired labour employed on the farm may be estimated by adding the following cost items:

i) amount paid as cash;
ii) value of wages paid in kind;
iii) value of food provided;
iv) value of cloths provided;
v) value of shoes provided; and
vi) value of other miscellaneous payments.

Using this procedure, total labour cost (of family and permanent hired labour) can be estimated for the whole year. Total working hours of these two types of labour needs to be estimated by taking into consideration the operations performed and the time spent on each operation for each farm enterprise. The cost of the above labour may be apportioned to various enterprises on the basis of working hours spent on each of them. Cost per working hour can be derived by dividing total labour cost with the total working hours. If per hour cost is multiplied by labour hours spent on each enterprise, it gives the labour cost for that enterprise.

Before apportioning labour cost to various types of livestock, these may be converted into adult animal units using the following rations conversion ratios:

Production Animals	Animal units
Adult cow	0.72
~~Young cow~~	0.54
Adult buffalo	1.28
~~Young Buffalo~~	0.96
Work Animals	
Bullock	1.0
Donkey	0.57
Horse	1.00
Camel	1.57
Other Livestock	
Sheep	0.20
Goat	0.20

c) **Casual Hired Labour**

Actual payment made to the casual hired labour, if any, may be charged as such to the enterprise for which it was engaged.

To arrive at the net cost, value of farm yard manure produced by the animals needs to be deducted from gross costs.

II. CAPITAL INPUT

i) Interest and Depreciation on the Value of Milch Animals

Depreciation charges for milch animals can be computed by taking the difference in their value at the beginning and that at

the end of the year. One major criticism to this method of calculation is that of the increase in the value of milch animals due to appreciation in their prices upto a certain age of milch animals. Another objection to this method is that the value of a milch animal is a function of age and time of parturition. It is quite possible that an animal may be dry at the beginning of the year and turns wet at the end of the year. The time of parturition consequently affect the value of milch animal. In order to overcome these problems, depreciation may be charged at the rate of 5.50 percent on the average value of the animal during the milking period.

In most of the cases, the farmers do not dispose off the milch animals when they go dry, rather they keep them on their farms. On calving again, the animal becomes as valuable as it was at the time of previous calving. There is, therefore, no depreciation in the price of the animals between two calvings. However, maintenance cost for that period is involved. Such maintenance costs during the dry period may be estimated and be taken as the true cost of milk production instead of the depreciation cost.

Interest could be charged at the level of opportunity cost, which in Pakistan ranges between 12 to 14 percent on the average price obtained during the maximum and the minimum prices of the animal.

ii) Interest and Depreciation on the Value of Shed

In rural areas, animals including the milch animals are commonly kept under the same shed. For the purpose of cost estimation, depreciation should be charged at the rate of 2.5

percent and 5 percent of the current construction cost of the "pacca" and the "katcha" sheds, respectively; while the interest is charged at the rate of 12 percent (depending upon the opportunity cost of capital. Animal shed costs can then be apportioned to various animals, on the basis of adult animal units, using the following formula $MF = SC \times \frac{MA}{TA}$

Where

MF = The Shed cost for milch animals.

SC = The total shed cost in rupees.

MA = The milch animal units.

TA = The total animal units.

iii) Green fodder and dry fodder

Total cost of green fodder can be calculated as

$$TCG_f = \sum_{i=1}^{N} FF_i \; PF_i - \sum_{i=1}^{N} FS_i \; PR_i + \sum_{i=1}^{N} FP_i$$

Where

TCG_f = Total cost of green fodder fed to livestock,

FF_i = Area under ith type fodder on the farm,

PF_i = Prevailing price per acre of ith fodder in the village in rupees,

FS_i = Area under the ith fodder grown on the farm but sold,

PR_i = Price per acre received for the ith type of fodder sold,

PF_i = Area purchased of the ith fodder and

FP_i = Price per acre paid for the ith fodder purchased.

Similar procedure can be used for estimating the cost of dry fodder fed to all animals. The share of milch animals can be derived from the total cost on green and dry fodder by using the following formula

$$CMA = TCF \times \frac{MA}{TA}$$

Where

CMA = Cost of green and dry fodder fed to milch animals in rupees,

TCF = Total cost of green and dry fodder fed to livestock,

MA = Milking months and

TA = Total animal months.

iv) Concentrates

The value of cotton-seed cake, cotton seed, ghee, oil, etc., fed specifically to milch animals may be taken as the cost of concentrates.

v) Labour Cost for Maintenance

Labour use for the livestock sector is a function of variables like fodder cutting, chaffing, feeding, watering, milking, etc. Total labour used in livestock sector can be estimated as

$$THL = \sum_{i=j}^{2} \sum_{j=i}^{n} X_{ij}$$

Where

THL = Total hours spent on the livestock sector and

X_{ij} = Total hours spent on livestock sector in the ith season for the jth operation.

Absolute amount of the labour used for milch animals from the common employment of labour for all animals can be estimated by using the following relationship

$$MLH = THL \times \frac{DA_i}{TA}$$

Where

MLH = Labour used for milch animals,
THL = Total hours spent on livestock sector,
DA_i = Standard milch animal months,
TA = Total standard animal months.

Family labour and permanent hired labour cost for wet animals can be derived by using following relationship

$$MLC = LH \times CA.$$

Where

MLC = Labour cost of milch animals,
LH = Total manual hours of family labour and permanent hired labour spent on milch animals and
CA = Cost per man hour.

Actual payment made to the casual hired labour was apportioned to the milch animals in proportion to its use.

vi) Interest on the value of Land

An interest rate of 12 percent (depending upon the opportunity cost of capital) may be applied on the value of land used for tying the animals on a given piece of land. This interest cost should be allocated to different animals categories, following the procedure given for the shed cost.

COST OF MILK PRODUCTION

Milk output is a function of age, lactation number, calving month, feeding practices, etc. Due to these variables milk production per day varies over time.

Since an animal may be wet/dry over a certain period, one should estimate the total milking months and total milk production.

Cost per Kg of milk can be derived by dividing the cost of total milking period by the total milk produced during that period.

COST OF BEEF PRODUCTION

An identical procedure can be used for estimating cost of various items for the purpose of beef production as discussed for milch animals. The only exception is that of depreciation cost. Weight gain during the year can be estimated using the following formula:

$$WG = WY_2 - WY_1$$

Where

WG = Weight gained during the year in Kgs,

WY_1 = Weight of the animal in the beginning of the ear in Kgs and

WY_2 = Weight of the animal at the end of the year in Kgs.

Gain in weight during the year can be used to estimate the carcass weight. It is assumed that the percentage of dressed meat is 54.8. Cost per kg of beef is equal to the total cost divided by the total dressed weight. Cost of production of per kg of buffalo milk and beef in the Punjab for a year is presented in Tables 4.1 and 4.2, respectively.

Table 4.1: Cost of production per kg of buffalo milk.

Items of Cost	Amount (Rs.)	Percentage of total
Family and permanent hired labour	1.83	12.99
Casual hired labour	-	-
Concentrate:		
i) Cotton seed cake	1.66	11.79
ii) Others	-	-
Fodder:		
i) Kharif Fodder	1.03	7.31
ii) Rabi Fodder	3.02	21.45
iii) Rabi others	0.29	2.06
iv) Dry Fodder	0.40	2.84
Interest cost on animal	0.42	2.98
Depreciation cost of animal	3.47	24.64
Interest and depreciation cost on animal sheds	0.32	2.28
Interest on open space	0.10	0.72
Implement cost	0.22	1.56
Miscellaneous cost	0.40	2.84
Value of milk fed to calves	0.92	6.53
Total cost	14.08	100.00
Income from FYM	0.44	-
Net cost	13.64	-
Price/Kg.	10.12	-
Net return/Kg.	-3.52	-

Table 4.2 Cost of production of hiefer of buffalo.

Item of Cost	Overall	
	Rs./Kg	%age
Labour	11.02	32.17
Fodder:		
i) Kharif Fodder	2.72	7.94
ii) Rabi Fodder	4.68	13.66
iii) Rabi others	1.42	4.14
iv) Dry Fodder	2.09	6.10
Interest on animal value	2.60	7.59
Interest and Depreciation cost on animal sheds	3.67	10.72
Interest cost on open space	1.56	4.55
Implement cost	3.24	9.45
Miscellaneous cost	1.26	3.68
Total cost	34.26	100.00
Income from FYM	2.64	-
Net cost per Kg. at Farm Level	31.62	-

CHAPTER V

FARM BUSINESS ANALYSIS

The major objectives of undertaking farm business analysis are:

a) to know the status of business at a particular point in time;
b) to identify the weak and strong points in business; and
c) to make necessary changes for effecting desired improvements in farm business.

Farm business essentially involves proper record keeping and maintainence of accounts, their analysis and presentation of results. Scientific planning and skillful organization of farm business can greatly help achieve higher levels of earning in livestock enterprises.

Maintenance of farm records is a crucial first step towards prospective higher earnings. The more specific benefits of keeping farm records are:

a) these help determine and rank various enterprizes in terms of level of profitability;
b) these help ascertain week and strong points of the farm business as a whole and also of specific individual enterprises;
c) these records help assess the financial position of business at a point in time;

d) in a historical context, farm records provide good basis for evaluating the gains and losses in farm business over time;

e) for purposes of drawing future business plans, farm records make available very useful information or inputs costs and their structure;

f) entrepreneurial Management, with ready access to these records, can make management decisions rather promptly; and

g) based on farm records, causes to variable performance of farmers under similar conditions can be rightly pin pointed.

FARM BUSINESS RECORD SYSTEM

There are tow major parts of the farm business record system. These include: A) physical farm records, and B) financial farm records. There is a third dimension to these records and that is supplementary farm records.

A. Physical Farm Records

These records are concerned with the physical aspects of the operation of a farm business. The farm activities recorded here include the following:

1) general farm location map and layout, etc.;
2) land use;
3) cropping pattern;
4) crop production and disposal;
5) livestock production and disposal;
6) farm Machinery;

7) labour;
8) fodder production and fodder use;
9) feeds;
10) calving intervals and dates;
11) water use; and
12) milk production and marketing.

1. General Farm Records

There are several items which mostly pertain to the physical features of farm. These include farm maps, soil map, farm stead map and contour map.

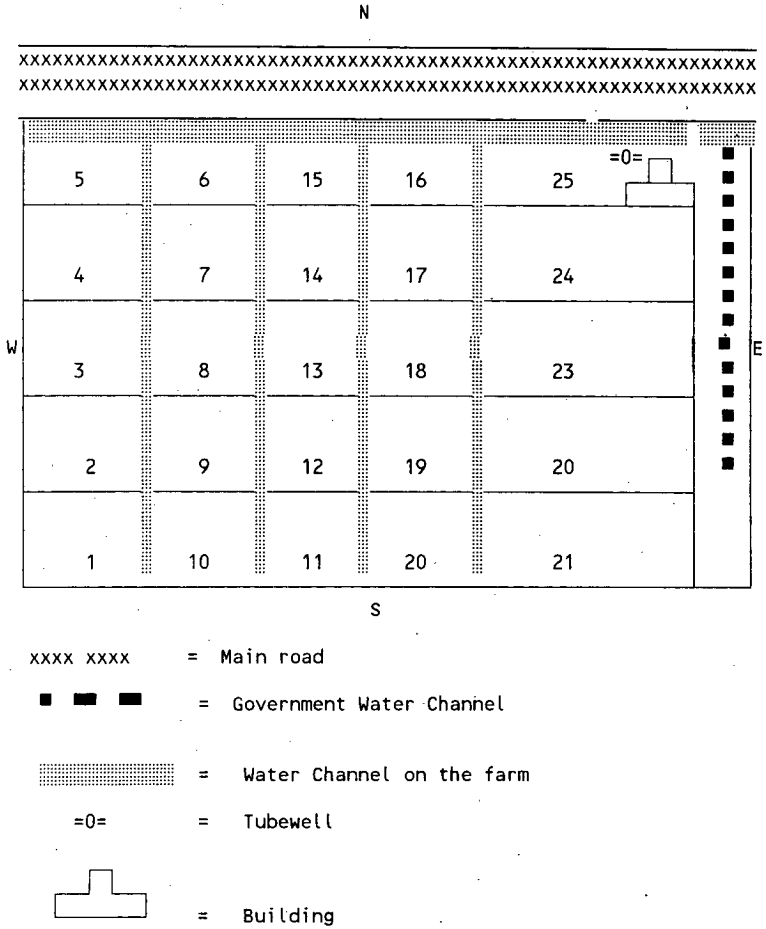
i) Farm Map

Farm map can be used for a variety of purposes. It shows the important physical features and the field arrangements. It helps in sketching any proposed changes in the layout fields and water channels, etc which can essentially result in most efficient field arrangements. Another important use of a farm map is that it facilitates in drawing plans and records for cropping programmes. For instance, crops to be grown in the coming years, quantities of farm yard manure and fertilizer to apply, likely seeding rates to follow, crop varieties to be sown, water level and plant protection measures to be adopted, can all be recorded on the map. Moreover, the actual plan including yield and problems such as water logging and salinity, weed infestation, wild bore attack etc. can also be noted on the map for each field for future reference. An example of a farm map in Faisalabad district is presented in Figure 5.1.

ii) Soil Map

Every farmer must be familiar with the types and characteristics of the soils in each field. Crop yields, and levels

Figure 5.1. Farm Layout Map in Faisalabad.



of use of fertilizer and farm yard manure are all a function of the nature of soil. The soil map greatly helps in farm planning and budgeting. Crops like gram, etc are well adapted to sandy soils, while food grain crops like wheat and maize yield do well on clay loam soils. Good knowledge of soils and soils classification is necessary to prepare an accurate soil map.

iii) Farmstead Map

A well designed farmstead map is essential when a farmer is planning for new farm buildings including sheds for animals.

2. Land Use Record

These records provide information about the use of farm land (Format is given in Table 5.1).

Table 5.1 Land Use Record (Acres)

Particulars	Years		
	1994	1995	1996
Farm Size			
Cultivated Area			
Net cropped area			
Area cropped more than once			
Total cropped area			
Fellow area			
Uncultivated Area			
Forest area			
Area under building road etc.			
Culturable waste			

3. Cropping Pattern Record

This record shows the area put under various crops during the year is given in Table 5.2.

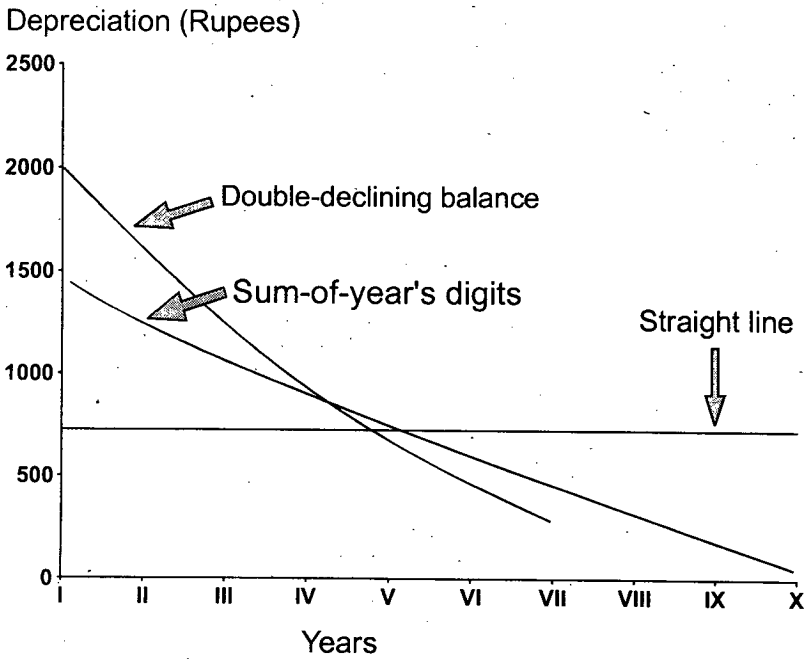
Table 5.2 Format for Cropping Pattern Record

Name of crop	1994	1995	1996
Kharif			
Sugarcane			
Cotton			
Kharif fodder			
Maize			
Sesamum			
Other crops			
Subtotal			
Rabi			
Wheat			
Rabi fodder			
Toria			
Other crops			
Sub total			
TOTAL			

4. Crop Production and Disposal Record

These records provide ready information about the actual performance of various farm enterprises. Detailed production records of each field have several important uses including profitability analysis. As an example, record of cotton crop is

Figure 5.2: Comparison of Depreciation Using Three Methods



shown in Table 5.3. Information about preparatory tillage, method and time of sowing, variety or varieties sown, fertilizer and farm yard manure applications, plant protection measures adopted, irrigations applied etc. are recorded in it. Record of package(s) of insecticides/pesticide used for cotton is very important as it is considered to be the key input for this crop. The information can be used to plan next year's crop for each field to prevent any inadvertent crop damage, especially from cotton leaf curl virus disease. Moreover, formats for recording crop production and disposal in general are given in Table 5.4 and 5.5, respectively.

Table 5.3 Format for Cotton Crop Production Record

Variety_____Area_____

Item	Quantity/Number	Date	Remark/Name
A. Land Preparation			
1. Irrigation			
(Katchi Rawane)			
Kanal			
Tubewell			
B. Preparatory Tillage			
a) Disk plough			
Chisel			
Rotavator			
Sub-soil			
b) M.B. (Tractor)			
c) M.B. (Bullock)			
d) Cultivator (Tractor)			
e) Cultivator (Bullock)			
f) Planking (Tractor)			
g) Planking (Bullock)			

Item	Quantity/Number	Date	Remark/Name

C. Irrigation

Pacci Rawani
Canal
Tubewell

D. Seedbed Preparation

a) Cultivator (Tractor)
b) Cultivator (Bullock)
c) Leveller (Tractor)
d) Leveller (Bullock)
e. Planking (Tractor)
f. Planking (Bullock)

E. **Farm Yard Manure Applied**

F. **Method of Sowing**

Tractor (Drill)
Bullock (Drill)
Pora
Kera
Broadcast

G. **Time of Sowing**

H. **Seed**

Dense population
Average population
Thin population

I. **Fertilizer Application (Bags) at the time of sowing**

Urea
DAP
SSP
NP
Other (Specify)

Item	Quantity/Number	Date	Remark/Name
	Fertilizer Application (Bags) after sowing (Ist dose)		
	Urea		
	DAP		
	SSP		
	NP		
	Other (Specify)		
	Fertilizer Application (Bags) after sowing (2nd dose)		
	Urea		
	DAP		
	SSP		
	NP		
	Other (Specify)		
	Fertilizer Application (Bags) after sowing (3rd dose)		
	Urea		
	DAP		
	SSP		
	NP		
	Other (Specify)		
J.	**Thinning done**		
K.	**Irrigation Applied**		
	Canal		
	Tubewell		
L.	**Weed intensity**		
	High		
	Medium		
	Low		
	Nil		

Item	Quantity/Number	Date	Remark/Name
M. **Insect Attack**			
High			
Medium			
Low			
Nil			
N. **Pesticide Application**			
Ist Speay			
II Spray			
III Spray			
IV Spray			
V Spray			
VI Spray			
VII Spray			
O. **Picking**			
P. **Yield Per Acre**			
Q. **Price Per Kg**			
R. **Income/acre**			

5. Format for Livestock Production and Disposal Records

Format for livestock production records is given in Table 5.6, while format for the disposal record is shown in Table 5.7.

Table 5.4: Disposal of Crops

	Area (Acres)	Yield per acre	Total production
Kharif Crops:			
Sugarcane: Main crop			
By-product			
Cotton : Main crop			
By-product			
Maize : Main crop			
By-product			
Rice : Main crop			
By-product			
Kharif fodder			
Others			
Rabi Crops			
Wheat : Main crop			
By-product			
Oilseed : Main crop			
By-product			
Rabi fodder			
Others			

Table 5.5: Production of Crops

Crop	Domestic		Used as seed		Used as feed		Sold		Balance at the end of the year	
	Qty	Value	Qty	Value	Qty	Value	Qty	Value	Qty	Value
Kharif Crops:										
Sugarcane: Main crop										
By-product										
Cotton : Main crop										
By-product										
Maize : Main crop										
By-product										
Rice : Main crop										
By-product										
Kharif fodder										
Others										
Rabi Crops										
Wheat : Main crop										
By-product										
Oilseed : Main crop										
By-product										
Rabi fodder										
Others										

Table 5.6 Production of Livestock Products

Product	Quantity (Kg)	Price (Rs)	Value (Rs)
Milk:			
Buffalo			
Cow			
Sheep			
Goat			
Wool:			
Sheep			
Goat			
Eggs			
Others			

Besides livestock production and disposal records, livestock breeding records should also be maintained. These help in conducting appropriate analysis and bringing about needed improvements in a commercial breeding herd. Various types of forms for breeding records can be used. One type suitable for a herd meant for beef is given in Table 5.8.

Table 5.7: Livestock changes and disposal record

Type of Animal	Inventory in the beginning of the year		Purchased during the year		Produced		Sold		Consumed		Died/ Theft		Inventory at the end of the year
	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	
Buffaloes													
Wet♀													
Dry♀													
Breeding bull													
Heifers (1-3 years)													
Youngstock													
Cows													
Wet♀													
Dry♀													
Breeding bull													
Heifers (1-3 years)													
Youngstock													
Bullocks													
Horses													
Sheep													
Goat													
Camel													
Poultry													

Table 5.8: Format for Beef Breeding and Performance Record.

Cow/Buffalo Number_____ Breed_____

Birth date or when acquired_____

Year	Date breed	Sire	Due date	Calving date	Information about calf			Remarks
					Sex	Birth weight	Wean weight	

6. Farm Machinery Record

Two types of record can be maintained for machinery. The first is a entirely cost related (Table 5.9). It makes specific provision for the calculation of cost of various items of machinery. It also includes information about the costs incurred on items like fuel, oil and lubricant, repairs and maintenance. Entries on this format can be made daily or weekly.

The second type of record deals with the farm machinery use (Table 5.10). This format records information about the use of different machines on various operations related to various crop activities. Information can be recorded on various operations done on different dates.

Table 5.9 Farm Machinery Costs Record

Item_____Year_____Date purchased_____

Date	Hours of use	Fuel		Oil and lubricants		Repair and Maintenance	
		Liters	Cost (Rs)	Qty	Cost (Rs)	Cost (Rs)	Remarks

Table 5.10 Farm Machinery Use Records

Name of farm machinery_____Make_____

Date of purchase_____

Name of crop	Plough-ing (Hours)	Planking (Hours)	Transport ation of farm yard manure (Hours)	Transport of the main (Hours)	Transport of the by-product (Hours)
Kharif					
Sugarcane					
Cotton					
Maize					
Rice					
Kharif fodder					
Other					
Rabi					
Wheat					
Oilseed					
Rabi fodder					

7. Farm Labour Records

Farm labour records are of two types. The first type records information on a weekly or monthly basis with respect to labour use for various operations including machine operations for each farm enterprise. Formats for labour record for cotton crop and general livestock are given in Table 5.11 and 5.12, respectively. Besides the labour records for each enterprise, aggregate farm records (Table 5.13) should also be kept. This record includes information on labour use not only for various farm enterprises but also information on labour use for other farm related general activities like marketing of farm products, repair and maintenance of machinery, channel cleaning, etc.

8. Fodder Production and Fodder Use Records

Records of fodder production and use are very important for the livestock. These should be maintained on monthly/seasonal basis as these help in identifying periods of fodder shortages etc and also indicate fodder use pattern for livestock at the farm (Table 5.14).

9. Feed Records

Feed records can be maintained for each type of livestock fed on a separate ration (Table 5.15 and 5.16). Such records can be used to determine the feed efficiency and to estimate profitability per animal. These records can be maintained for fodder, concentrates and other miscellaneous feed items on daily basis for each animal as well as for the herd as a whole (Table 5.17 and 5.18). Aggregate feed consumption records can also be

Table 5.11: Labour Record of Cotton Crop

Ploughing and Seedbed Preparation			Sowing			Fertiliser application		Irrigation		Thinning		Inter-culture		Pesticide applica-		Picking		Harvesting	
Date	Hours		Date	Hour		Date	Hour	Date	Hour	Date	Hour	Date	Hour	Date	Hour	Date	Hour	Date	Hour
	Man	Tractor		Man	Tractor														

Table 5.12: Labour Record of Livestock

Activity	Kharif season		Rabi Season		Total	
	Hour	Value	Hour	Valur	Hour	Value
Fodder cutting						
Transport						
Chaffing						
Feeding						
Concentrate Serving						
Watering						
Bathing						
Dung removing						
Milking						
Medical Service						
Bed Spreading						
Grass cutting						
Grazing						
Exercising						
Others						
Total						

Table 5.13: Aggregate Farm Labour Record (Hours)

Activity	Crop											Oth er	Total
	Sugarcane	Cotton	Maize	Rice	Kharif fodder	Wheat	Rabi fodder	Oil seed	Others	Sub Total	Live-stock		
Ploughing Tractor(T) Bullock(B)													
Planking T B													
Fertilizer													
Thinning													
Irrigation													
Pesticides													
Harvesting/Picking													
Farm Yard Manure													
Transportation													
Fodder/grass cutting													
Chaffing													
Feeding													
Watering/Bathing													
Milking													
Others													

Table 5.14: Fodder Production and Use Record

Name of fodder	Area	Quantity produced	Fodder requirement				Surplus/ deficit
			Milch	Draught	Other	Total	
Green fodder							
Sorghum							
Maize							
Guara							
Berseem							
Lucern							
Wheat Bhoosa							
Others							

Table 5.15: Feed Reeord of Buffaloes

Buffalo No

Date	Consumption (Kg)												
	Bhusa	Green fodder						Concentrate					
		Sorghum	Maize	Berseem	Lucern	Guara	Others	Cotton seed cake	Cotton seed	Oil seed cake	Wheat	Others	
Total													

Table 5.16: Miscellaneous items fed to Buffaloes

Buffalo No._____

Date	Gur	Salt	Ghee	Medicines
Total				

Table 5.17: Fodder and concentrate consumption for a particular month/season/year.

Date	Consumption (Kg)											
	Bhusa	Green fodder						Concentrate				
		Sorghum	Maize	Berseem	Lucern	Guara	Others	Cotton seed cake	Cotton seed	Oil seed cake	Wheat	Others
Buffalo												
Wet												
Dry												
Heifer												
Young stock												
Breeding Bull												
Cows												
Wet												
Dry												
Heifer												
Young stock												
Breeding bull												
Draught animals												
Camels												
Donkey												
Horse												
Sheep												
Goat												
Others												
Total												

Table 5.18: Miscellaneous items fed to Animals

Date	Gur	Salt	Ghee	Medicines
Buffaloes:				
Wet				
Dry				
Heifers				
Young stock				
Breeding Bull				
Cows:				
Wet				
Dry				
Heifers				
Young stock				
Breeding Bull				
Draught Animals				
Camal				
Horse				
Donkey				
Sheep				
Goat				
Others				
Total				

maintained on monthly basis to determine the total requirement of various feeds.

10. Farm Records for Calving Interval and Calving Dates

Calving interval records are useful to evaluate the performance of individual animal. Information pertaining to mating date, bull used, date of calving etc. is recorded (Table 5.19).

11. Water Use Records

These records are used to see the spread and number of irrigations applied to different crops. Source of water (i.e. canal or tubewell) is also indicated along with the quality of water (Table 5.20).

12. Milk Production and Marketing Records

Such records are useful to determine the quantity of milk produced in different months of the year. Besides that, the quantity marketed is also recorded along with the price received (Table 5.21).

B. FINANCIAL RECORD

These records are concerned with the financial aspects of the operation of a farm business. These records include: 1) Farm Inventory; and 2) Farm financial or cash Accounts.

Table 5.19: **Calving Interval and Calving Dates Record**

Animal type	Animal Number	Breeding date	Bull used	Due date	Calving date	Sex of calf	Birth weight

Table 5.20: Water Use Record

Crop	Quantity of Tubewell Water	Jan.		Feb.		Mar.		Apr.		May		Jun		July		Aug.		Sep.		Oct.		Nov.		Dec.	
		C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T

C = Canal
T = Tubewell

Table 5.21: Milk Production of Marketing Record

	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Buffalo												
1.												
2.												
3.												
Cows												
1.												
2.												
3.												
Total												
Quantity consumedby the farm household(litres)												
Quantity sold (litres)												
Price/litre												
Total income												

1. Farm Inventory

An inventory is a list of all physical and financial items owned by the farmer at a given point of time. It includes personal property such as livestock, machinery, bank balances etc and real property such as land and buildings. To be more useful, the inventory must be in monetary terms. Therefore, an inventory consists of two parts, i.e., the physical count and the valuation.

Inventory changes provide a sound basis for farm business planning. It shows how much money is tied up in each enterprise. It also indicates how the financial position of the farmer has changed during the year by determining the difference between the closing and beginning inventories. Change in inventories may both be in depreciable and non-depreciable assets. The wear, tear and obsolescence of capital item causes a decrease in value and is called depreciations.

In Pakistan, animals of substantial value are on hand at the beginning and end of the year at almost each farm. For determining the true profit for the year, an inventory is prepared which indicates the number and value of each kind of asset. Taking the inventories, involves counting the number of asset and this itself provides useful information. Method of valuation of each type of asset should be consistent over time. This value must be the same from year to year in order to avoid unrealized profits or losses due to changes in valuation. An inventory valuation proforma can be used to asses the changes in inventory (Table 5.22).

Table 5.22 Inventory Valuation Performa

Type of livestock	Inventory at the beginning of the year		Inventory at the end of the year	
	Number	Value (Rs)	Number	Value (Rs)
Buffalo:				
Buffalo				
Heifers				
Young stock				
Male				
Female				
Cattle:				
Cow				
Heifers				
Youngstock				
Male				
Female				
Bullock				
Sheep.				
Goat				
Donkey				
Horses				
Camel				
Poultry				

There are several methods of valuation. Every method has its own advantages and disadvantages. The choice of valuation method depends on the nature of asset and the purpose of valuation. Which ever method of valuation is used, the accounting concepts of conservation and consistency must be taken into account. Conservation stresses against placing high value on an asset, while consistency implies using the same valuation method over time. Comparative financial statements can be obtained for various years by using these concepts. Most commonly used valuaion methods are:

i) net market price; ii) cost; iii) lower of cost or market price;iv) farm production cost; v) Cost less depreciation; and vi) income capitalization.

i) Net Market Price

An asset is valued at the net market price which is estimated by subtracting the marketing charges such as transportation, octroi charges, commission agent fee etc from the market price. This method can be applied to crops and livestock enterprises. However, it has little usefulness for other assets like buildings and farm machinery.

ii) Cost

In this method, valuation is made at the cost at which an item was purchased. This method is useful for recently purchased items. Items like fertilizer, feed, pesticides, seed etc. can be valued at the original cost. Land can also be valued in this way. Assets like buildings and machinery which lose their value over time due to depreciation should not be valued using

this method. Similarly, livestock and crops produced on the farm should not be valued using this method since they have no purchase price.

iii) Lower of Cost or Market price

This method involves valuation of an asset using net market price or its cost and be chosen whichever has the lower value. This method makes use of conservative concept as it reduces the chance of using too high value on an asset. Use of this method eliminates any increase in inventory value resulting solely from inflation.

iv) Farm Production Cost

Items produced on the farm and still on hand can be valued at the level of their farm production cost. The actual cost of production of an item should not include profit associated with its production. This method can be used for the valuation of fodder produced on the farm. However, it should not be used for the valuation of the standing crops, as weather conditions can drastically change the value of crop.

v) Cost Less Depreciation

Items which can be used overtime and lose their value due to age, use or obsolescence should be valued at the original cost less depreciation. This method is suitable for valuation of machinery, buildings and purchased breeding livestock. At the end of each year, value of the item is reduced by the amount of depreciation for that year. The value in the current time period

is obtained by subtracting the total accumulated depreciation (from the date of purchase) from the original cost.

vi) Income Capitalization

This method is appropriate for items like land which have a long life and their contribution to the income of the farm business can be measured. Following formula can be used for this purpose.

$$V = \frac{R}{i}$$

Where;

V = the value of an asset in rupees,
R = the constant flow of income over an infinite period and
i = the rate of interest.

As the interest rate and the annual income flow are not known with certainty, therefore, this method is used in combination with other methods like market price.

DEPRECIATION

The concept of depreciation is involved in some of the methods of valuation. It is, therefore, important to understand this concept and its various methods of calculation. Depreciation implies a decline in the value of a given asset due to its use, wear and tear and absolescene. There are two views regarding the depreciation concept: 1) it shows a loss in value of an asset

due to use in business to produce income; and 2) it is a way to spread the original cost of an asset over its useful life. It is not correct to deduct the full purchase price in the year of purchase as the asset is used for producing income over many years. It is always appropriate to spread the depreciable amount, obtained by deducting the salvage value from the purchase price, over the useful life of the asset.

Salvage value is the assigned value to an asset at the end of its useful life. A positive salvage value should be assigned to an asset if it can be disposed off as scrap or can be sold before it is completely worn out. In general, the longer the useful life, the lower the salvage value. Useful life of an asset is the expected number of years, the asset will be used in the business.

Various methods of computing depreciation are: a) Annual revaluation; b) Straight line method; c) Declining balance method; and d) Sum-of-the-year-digits method.

a) Annual Revaluation

In this method the cost is reduced every year, the difference between the value of the asset at the beginning of the year and the value at the end of the year is called the depreciation or appreciation. This method is useful for livestock in early years of appreciation stage, i.e., male and female calves.

b) Straight Line Method

This is the most commonly used and is the easiest method of calculating depreciation. The amount of depreciation is the same for each year. This is also the slowest method for claiming

depreciation. Annual depreciation is computed by applying the following formula:

$$D = \frac{C-S}{L},$$

Where;

D = annual depreciation.
C = the purchase price of the asset.
S = salvage value and
L = expected useful life in years.

In straight line method, depreciation can also be computed using an alternative formula:

$$D = (C-S) \times R,$$

where R is the annual depreciation rate found by dividing 100 percent by the useful life of the asset.

For example, assume the purchase price of fodder chaffing machine is Rs. 10000. Its salvage value is Rs. 2000 and its useful life is 10 years. Annual depreciation using the first formula would be

$$\frac{10000-2000}{10 \ years} = Rs.800/-$$

Using the second formula, the percentage rate would be 100 percent divided by 10 or 10 percent and the annual depreciation is

(10000 - 2000). 10 % = Rs. 800

The total depreciation over the 10 years would be Rs. 800 x 10 = Rs. 8000., reducing the machine's book value to its salvage value of Rs. 2000.

C) Declining Balance Method

In this method, a fixed rate of depreciation is applied for every year to the value of the asset at the beginning. No salvage value is deducted from the original cost when computing annual depreciation. The amount of depreciation is calculated by applying a constant percentage rate to the book value, which declines each year by an amount equal to the previous year's depreciation.

Several types of declining balance depreciation are possible, but the most common is the double declining balance. i.e., depreciation rate is double the straight line rate. This method gives higher depreciation charges during the earlier years of the life of an asset and lower charges for later years.

Using the previous example of fodder chaffing machine, the double declining balance rate would be 2 times 10 percent i.e., 20 percent. This procedure is explained in Table 5.23.

Table 5.23 Declining Balance Method of Depreciation

Year	Value at the beginning	Annual depreciation	Remaining balance
I	10,000	2000	8000
II	8000	1600	6400
III	6400	1280	5120
IV	5120	1024	4096
V	4096	820	3276
VI	3276	656	2620
VII	2620	524	2096

We should continue to take 20% of the remaining value, until salvage value is reached, as in this case about Rs. 2096.

d) Sum-of-the-year's Digits

In this method high depreciation charges are obtained for the first few years of the use of an asset and low charges for the later years. In this method, no undistributed balance is left over as was in the case of declining balance method. The annual depreciation is calculated from the following equations:

$$D=(C-S)\times\frac{RL}{SYLA}$$

Where, D, C and S have already been defined. RL shows the remaining years of useful life at the beginning of the year when depreciation is being computed.

SYLA represents the sum of years of useful life. For example, for a ten-years useful life SYLA=1+2+3+....8+9+10=55 and for five-years useful life SYLA= 1+2+3+4+5=15.

Continuing with the previous example of fodder chaffing machine SYLA = 55. The annual depreciation will be calculated as follows:

$$Year\ I = (Rs.10000 - Rs.2000) x \frac{10}{55} = 1454.55$$

$$Year\ II = (Rs.10000 - Rs.2000) x \frac{9}{55} = 1309.09$$

$$Year\ III = (Rs.10000 - Rs.2000) x \frac{8}{55} = 1163.64$$

$$Year\ IV = (Rs.10000 - Rs.2000) x \frac{7}{55} = 1018.18$$

$$Year\ V = (Rs.10000 - Rs.2000) x \frac{6}{55} = 872.72$$

$$Year\ VI = (Rs.10000 - Rs.2000) x \frac{5}{55} = 727.28$$

$$Year\ VII = (Rs.10000 - Rs.2000) x \frac{4}{55} = 581.82$$

$$Year\ VIII = (Rs.10000 - Rs.2000) x \frac{3}{55} = 436.36$$

$$Year\ IX = (Rs.10000 - Rs.2000) x \frac{2}{55} = 290.90$$

$$Year\ X = (Rs.10000 - Rs.2000) x \frac{1}{55} = 145.45$$

e) Comparison of Depreciation Methods

Figure 5.2 compares the annual depreciations computed using three methods. Declining balance and sum-of-the-year's digits methods have higher annual depreciation than the straight line method during the early years, while reverse is true for the later years. These various depreciation methods affect only the pattern of distribution over time and do not change the total depreciation over the useful life. Choice of an appropriate method depends on the type of property; for example, in case of machinery like tractors, actual market value tend to decline more rapidly during the early years and more slowly in the later years. Fast depreciation methods, i.e., declining balance and sum-of-the-year's digits should be used. For building, which have little or no market value and provide uniform flow of services, straight line method would be more appropriate.

NET WORTH STATEMENT AND INCOME STATEMENT

Two types of financial statements of a complete set of farm records are a balance sheet or net worth statement and an income statement (Table 5.24). These two statements serve different purposes. A balance sheet shows the financial position of the business at a point in time, while an income statement shows the income and expenses over a given period of time. A balance sheet can be made during any time of the year; but the usual time is at the end of year. This allows a statement both for the end of the year and for the beginning of the year. The primary purpose of a balance sheet is to measure the financial strength and the position of a business. The comparison of the net worth

Table 5.24. Balance Sheet for a farmer in Faisalabad District (as of December 31, 1995).

Assets		Liabilities. (Rs.)	
Current		Current	
a) Cash in hand	Rs. 5000	a) Short term loans	Rs. 5000
b) Saving Accounts	Rs. 10000	b) Fertilizers	Rs. 4000
c) Wheat (1000 Kg)	Rs. 5000	c) Pesticides	Rs. 6000
d) Cotton (600 Kg)	Rs. 12000		
e) Fertilizer	Rs. 1000		
f) Youngstock	Rs. 15000		
g) Sub-total(a to f)	Rs. 48000	d) Sub-total(a to c)	Rs.15000
Intermediate		Intermediate	
h) Machinery	Rs. 3,00,000	e) Machinery loans.	Rs. 2,50,000
i) Livestock	Rs. 40,000	f)Dairy animal loans.	Rs.1,00,000
j)(Buffaloes, Cows)			
k) Sub-total: (h to j)	Rs. 3,40,000	g)Sub-total: (e to f)	Rs. 3,50,000
Fixed		Long-term	
l) Land	Rs. 12,00,000	-	-
m) Building	Rs. 2,00,000	-	-
n) Sub-total (l + m)	Rs. 14,00,000		
o) Total Assets. (g + k + n)	Rs. 17,88,000	Total Liabilities. (d + g)	Rs.3,65,000

Net worth	=	Total Assets	-	Total Liabilities
Rs. 14,23,000	=	17,88,000	-	3,65,000

of one year with that of another is an effective way to determine the progress over time.

The simplest way to describe a net worth statement is to list all the things owned in business in one column and to list all the things owed in another column. The difference between these two columns is called the net worth. If the net worth is a negative figure, it means the business has more liabilities than assets. An important point about the balance sheet is that total assets must exactly be equal to the total liabilities plus net worth, i.e., bottom line values on both side of the balance sheet should be equal.

A. Assets

Assets and liabilities can be divided into three groups: a) Current assets; b) intermediate assets; and c) fixed assets.

a) *Current Assets*

These are the most liquid assets which can be used or sold in the next year. Their sale does not disrupt the future production activities. Cash in hand, seeds, fertilizers, livestock etc are the most liquid assets.

b) *Intermediate Assets*

Intermediate assets are less liquid as compared to current assets. Their life ranges from one to ten years. The examples of intermediate assets are farm machinery, equipment, breeding livestock etc.

c) *Fixed Assets*

Fixed assets are the least liquid of all the assets. They have a useful life of more than 10 years. Their sale would seriously affect the ongoing nature of a business. The examples of fixed assets are land, building etc.

B. Liabilities

Liabilities can be divided into three groups: a) current; b) intermediate; and c) long term liabilities.

a) *Current liabilities*

These are the financial obligations which must be met within one year from the date of balance sheet and include the payment of short term loans and the payment for farm supplies like fertilizers feeds, pesticides, etc.

b) *Intermediate Liabilities*

These liabilities can be deferred for the present year and their payment can be made between one to ten years. Most important intermediate liabilities include the medium term loans obtained for the purchase of farm machinery, dairy animals, etc.

c) *Long-term Liabilities*

These are payable beyond ten years. Example is the long term loan.

ANALYSIS OF FARM BUSINESS RECORDS AND INTERPRETATION OF RESULTS

A. Analysis of Net Worth Statement

The computed net worth shows only the absolute amount. It may not indicate the true picture of the soundness of the farm business. Therefore, these data are further analysed by using various ratios to know the effective measures of the financial position and the strength of the business. These ratios provide a standard unit of measurement that helps in comparing the business firms at a point of time as well as their overtime performance. There are four ratios which are commonly used to establish the soundness of the farm business. These are: (a) net capital ratio; (b) debt/equity ratio; (c) current ratio; and (d) working capital ratio.

a) Net Capital Ratio

This ratio is a measure of overall financial strength and solvency of the business. It can be computed using the following formula:

$$Net\ \ capital\ \ ratio = \frac{Total\ assests}{Total\ liabilities}$$

The term solvency is used to express the ability of a business to meet its debt. For the balance sheet presented, net capital ratio is $4.90 = (\frac{17,88,000}{3,65,000})$

A net capital ratio of one indicates that total liabilities are equal to total assets that shows zero net worth. If the net capital

ratio is less than one, then insolvency exists. This implies that if the business is liquidated, then the cash generated would not be sufficient to pay all the labilities. As a general rule, this ratio should ideally be two. However, one to one ratio is acceptable if the majority of the assets are other than real estate.

A net capital ratio which has been increasing over time, indicates the business is making financial progress.

b) Debt/Equity Ratio

This ratio shows the relationship of owned capital to borrowed capital. It is computed as:

$$Debt/equity\ ratio = \frac{Total\ liabilities}{Net\ worth} = \frac{3,65,000}{14,23,000} = 0.26$$

The smaller this ratio, the larger is the net worth relative to total liabilities indicating a stronger financial position.

c) Current Ratio

It is a ratrio between current assets and current liabilities. It is a ratio which measures liquidity of the business. It can be computed as

$$Current\ \ ratio = \frac{Current\ assests}{Current\ liabilities} = \frac{48,000}{15,000} = 3{\cdot}2$$

The importance of this ratio lies in the ability of the business to meet quick needs for money.

A current ratio equal to one implies current liabilities are just equal to current assets. A ratio less than one shows a potential liquidity problem. Ideally this ratio should be eight

assets to one liability, however, this will depend upon when the balance sheet is completed.

d) Working Capital Ratio (WCR)

This is an intermediate measure of both liquidity and solvency. It can be computed as:

$$WCR = \frac{Current\ assest\ +\ intermediate\ assests}{Current\ liabilities + intermediate\ liabilities} = \frac{3,88,000}{3,65,000} = 1.6$$

This ratio indicates whether the total value of current and intermediate assets exceeds the total value of current and intermediate liabilities. Therefore, it measures the liquidity over several years Ideally this ratio should be six assets to one liability.

B. INCOME STATEMENT

The income statement, also called an operating statement or profit and loss statement, is a summary of income and expenses over a given time period. An income statement is a list of all farm expenses and all receipts in a convenient form. All expenses are deducted from receipts to determine the net income for a particular year. Its primary purpose is to calculate profit for a given time period.

A typical statement is given in Table 5.25. Many entries could be further divided into various items, if necessary.

Table: 5.25 Income Statement for a Farm in Faisalabad District

Cash farm income	**(in rupees)**
A) Crop sales	
Cotton	15000
Sugarcane	12000
Wheat	1000
Maize	500
Kharif fodder	-
Rabi fodder	-
B) Livestock sales	
Milk	5000
Milk products	-
Animals:	
Buffalo	-
Cow	-
Youngstock	5000
Sheep	-
Goat	1000
Poultry	-
Eggs	-
C) Custom work	-
D) Machinery	-
E) Other cash income	1000
Total cash income	**Rs. 40500**
Cash farm expenses	
Farm yard manure	-
Ploughing/Planking	1000
Fertilizer	8000
Insecticide/Pesticide	3000
Casual labor hired	10000
Seeds	1000
Plants	-
Water	1000
Electricity	-
Fuel and oil	-
Feed purchased	5000
Repair and maintenance of machinery	-

Livestock purchased	-
Miscellaneous	2000
Fixed cash expenses	
Interest paid	1000
Insurance	-
Permanent labor	6000
Land revenue, water value etc	.2000
Total cash expenses	**Rs. 40,000**
Net cash farm income	Rs. 5000
Non cash adjustments to Income Depreciation	
Machinery and equipment	500
Building	3000
Total:	**Rs.3500**
Inventory changes:	
Crops	5000
Livestock	3000
Farm inputs	1000
Net inventory change	**Rs.9000**
Net farm income (Net farm income-Depreciation + Inventory changes	**Rs.6000**

C. Profitability Analysis

Net farm income obtained in the income statement measures the profit for the accounting period. Profitability is concerned with the size of profit relative to the value of resources used to produce the profit. A business may have positive profit but have a poor profitability if this profit is small relative to the value of resources used. For example, two farms with the same net farm income are not equally profitable if one uses much more capital

as compared to the other. Various measures can be used to evaluate profit and profitability. These are discussed below.

a) *Net cash income:* It is obtained by deducting the total cash operating expenses from total cash receipts.

b) *Net farm income:* It is obtained from net cash income, adjusted for changes in inventory and depreciation . It is the money available for family living, debt repayment and new farm investments.

c) *Farm earnings:* These are calculated by adding the value of farm products consumed at home to net farm income.

d) *Family labor earning:* It is obtained by deducting interest charges on farm capital from farm earnings.

e) *Return to Capital:* The return to capital or the return on investment is obtained by dividing the return to total capital by total farm assets. It can be written as:

$$\textit{Rate of return to capital} = \frac{\textit{Return to total capital}}{\textit{Total farm assets}} \times 100$$

This is determined using the following steps.

1. deduct interest paid on debt capital to net farm income to obtain adjusted net farm income;
2. obtain return to total capital by subtracting opportunity cost of labor and management from the adjusted net farm income; and

3. convert the return to total capital into a percentage by applying the above equation.

In the income statement (Table 5.25),

Net farm income	= Rs. 6000
Interest paid	= Rs. 1000
Adjusted net farm income	= Rs. 5000
Opportunity cost of labor and management (assumed)	= Rs. 2000
Return to capital	= Rs. 3000
Total farm asset (assumed)	= Rs. 35000

$$\textit{Rate of return to capital} = \frac{3000}{35000} \times 100 = 8.57\%$$

f) *Return to Labor and Management:*

This represents the net farm income which remained to be paid to farm labor and management after capital is paid a return equal to its opportunity cost. It is obtained by subtracting the opportunity cost of capital from the adjusted net farm income. If the opportunity cost of capital is 10 percent, the opportunity cost on total capital is Rs. 3500. Therefore, return to farmer's labor and management is Rs. 1500 (Rs. 5000 - Rs. 3500).

g) *Return to Labor:*

Return to labor can be computed by subtracting the opportunity cost of management from the return to labor and management:

Return to labor and management	= Rs. 1500
Opportunity cost of management (assumed)	= Rs. 1000
Return to labor	= Rs. 500

h) *Return to Management:*

Return to management can be found by deducting the opportunity cost of labor from the return to labor and management:

Return to labor and management	= Rs 1500
Opportunity cost of labor	= Rs. 900
Return to management	= Rs. 600

It may be noted that net farm income was not sufficient to provide labor, management and capital a return equal to their opportunity cost.

FARM EFFICIENCY MEASURES

Efficiency measures are of two types i.e., Physical and economic. Each of these measures can be computed using various methods, but most commonly used are discussed in this section.

Analysing the physical measures related to input and output levels, the economic principles for determining the profit maximizing levels of input and output levels should always be kept in mind. It should be noticed that physical efficiency measures could be very high but the farmer may be operating much below the profit maximizing point. The economic measures are either in rupee value or some rate or percentage relating to the resource use.

Overall performance of the cropping system can be evaluated using various methods, which are explained below.

1. *Crop Yield Index.* Crop yield index refers to the overall productivity level achieved on the farm in relation to the productivity level attained in the area. This requires information about the acreage and yield of each crop on a particular farm and on other similar farms (Table 5.26).

Table 5.26 Crop Yield Index

Crop Acres	Yield on a particular farm (in 40 kg)	Yield on other farm	Yield of particular farm relative to other farm yield (%)	Adjusted value
1	2	3	4= (2/3) X 100	5=1x4
Wheat 6	30	25	120	720
Cotton 4	25	20	80	320
Sugarcane 1	450	500	90	90
Maize 1	30	20	67	67
Total 12	-	-	-	1197

$$Crop\ \ yield\ \ index\ \ = \frac{1197}{12} = 99.75$$

2. Comparison of actual yield to potential yields.

3. Gross value of output per acre (GVOPA) which can be calculated as

$$GVOPA\ \ =\ \ \frac{Value\ of\ Crops\ Produced}{crop\ \ acres}$$

4. Cost of production: One should use the farm given in Table 5.27.

Table 5.27 Cost of Production

(Rupees)

Item	Cost on a Particular farm		Cost on Average Area	
	Total	Per acre	Total	Per acre
Seed				
Fertilizer				
Pesticide				
Machinery				
Others				
Total				

5. *Crop return per Rupee invested(CRPRI).*

It can be computed as

$$CRPRI = \frac{Total\ value\ of\ crops}{Total\ cost\ of\ production}$$

Return to per rupee invested should be at least Rs. 2.00

Efficiency Measure For Each Crop Enterprise

Various efficiency measures for crops can be computed as given in Table 5.28.

Table 5.28 Efficiency measures for crop enterprises

Item	Particular farm	Average of of the area
Crop yield per acre: Main product		
By Product		
Quantity of fertilizer used/acre.		
Nitrogenous		
Phosphate		
Potash.		
Quantity of pesticide used		
Value of pesticide applied		
Quantity of weedicide applied		
Value of weedicide applied		
Number of canal irrigations		
Number of tubewell irrigation		
Total tractor hours used per acre		
Total bullock hours used per acre		
Total manual hours used		
Quantity of seed used		
Price per kg of output: Main product		
By - product		
Gross income per acre		
Gross income per acre		
inch of water		
Variable cost per acre		
Gross margin per acre.		
Total cost per acre:		
Net income per acre		
Return per rupee invested		
Return to labour		
Return to capital		

Efficiency of Livestock Enterprises

Overall efficiency of livestock enterprises can be measured by using the following measures.

1) *Net value of livestock increase:* This shows the total income from livestock sales, their products and net increase in inventory value, minus livestock purchases.
2) *Return per 100 rupee feed fed:* It is computed by dividing the net value of livestock increase by the value of all feed fed and then multiplying 100.

Various physical and economic measures which can be used in various livestock enterprises are given in Table 5.29.

Table 5.29 Efficiency measures for various livestock enterprises

	Particular farm	Average of the area
DAIRY ANIMALS		
Milk production per animal		
Butter content (%)		
Concentrate fed per day (Kgs)		
Milk production per 100 kgs of concentrates		
Buffaloes/Cows in milk (%)		
Average calving interval (days)		
Number of dairy animals per full time worker		
Milk production per full time worker		
Mortality of dairy animals (%)		
Quantity of green fodder fed per animal		

Quantity of dry fodder fed per anima		
Price of concentrate per kg.		
Price of green fodder per 40 Kg		
Price of dry fodder per 40 Kg		
Average herd life (years)		
Returns per Rs. 100 of feed fed		
Feed cost per 100 kgs of milk		
Total cost per 100 kgs of milk		
Net income per dairy animal		
Net income per kg of milk Production		
Return per Rs. 100 invested		
BEEF ANIMAL		
Calf mortality (%)		
Calving interval (days)		
Mortality of beef buffaloes/Cows(%)		
Average weight of calves at the time of sale		
Average age of calves at the time of sale		
Average value of calves at the time of sale		
Live weight gain per day		
Price per kg of live weight		

Concentrates fed per head		
Price of green fodder per 40 kg		
Price of dry fodder per 40 kg		
Quantity of green fodder fed/calf.		
Quantity of dry fodder fed/calf		
Conversion ratio i.e., kg concentrat fed per kg live weight gain		
Gain in weight per kg of TDN.		
Returns per Rs. 100 of feed fed.		
Feed cost per kg gain in weight		
Total cost per kg gain in weight		
Net income per head		
Net income per kg gain in weight		
Return per Rs. 100 invested.		
SHEEP		
Lambing percentage		
Lambs born alive per 100 ewes		
Ewe mortality (%)		
Lamb mortality (%)		
Barren ewes (%)		
Quantity of feed fed/ewe.		
Number of ewes and lambs per full time worker.		
Grazing area per 100 ewes and lambs		

Lamb sold (%)		
Lambs retained for breeding (%)		
Average value of lamb at the time of sale.		
Average weight of lamb at the time of sale.		
Replacement rate (%)		
Average price of replacement		
Average flock life		
Total cost per ewe		
Net income per ewe		
Return per Rs. 100		
POULTRY		
LAYERS		
Egg production per bird in a given period		
Mortality rate (%)		
Quantity of feed fed per bird per day.		
Price of feed per 40 kg		
Price of culled birds		
Average price per dizen eggs		
Total cost per 100 birds		
Gross income per 100 birds		
Net income per 100 birds		

Returns per Rs.100 invested		
BROILER		
Weight of bird at the time of sale (kg)		
Mortality rate(%)		
Week birds were housed		
Quantity of feed fed per bird (kg)		
Gross in weight/kg of feed fed		
Price of feed per 40 kg.		
Total cost per bird.		
Gain income per bird		
Net income per bird		
Return per Rs. 100 invested		

CHAPTER VI

FARM BUDGETS

A budget may be defined as a plan for spendings and earnings for a given period of time, whic is usually one year. The success of budgeting is in fact an attempt at preparation of a detailed statement of the plan in quantitative terms. Basically, there are three types of farm budgets: i) Partial budget; ii) Enterprise budget; and iii) complete budget or whole farm budget. These are briefly discussed in the following sections of this chapter.

PARTIAL BUDGET

A partial budget refers to estimating profitability of small changes in an existing organization of a farm. It is a marginal analysis and shows the effect on net income resulting from the proposed change. Use of a partial budget is appropriate for making relatively minor adjustments in factor substitution and or product substitution. In factor substitution, one factor is substituted for another, e.g., changing from the conventional practice of manual wheat harveseting to machine cutting, plowing the land with tractor instead of bullocks, mechanical weeding instead of hand weeding, feeding of milch animals with cattle feed instead of cotton seed cake, etc. In product substitution, one product is substituted for another, e.g., wheat for gram, rice for cotton, maize for soghum, goat for sheep, buffalo for cow, etc.

The partial budgeting procedure consists of adding, subtracting or altering a part of the farm business to decide whether the change would be economically feasible. Only costs or returns resulting from the change are considered.

In preparing a partial budget, four items are taken into account. Two items relate to financial losses that are: 1) the new costs and 2) the revenue foregone; while the other two are concerned with financial gains which are (3) costs saved and (4) new revenue generated. The difference between losses (1+2) and gains (3+4) shows whether the proposed change is acceptable or not.

If the financial gains are more than financial losses, then the proposed change will increase the net income and will be attractive. If the financial gains are less than the financial losses, then the proposed change will decrease the net income and will not be desirable.

Assume a farmer has been feeding cotton seed cake to his milking animals besides the fodders grown on the farm. He has learnt that a new feed has been developed by a private manufacturing firm and this feed is being recommended for the dairy animals by the extension wing of the Department of Agriculture. The dairyman has to make a decision regarding a possible change over to the new feed. In this regard the detailed computations are given below:

1. Milk yield per animal per lactation with conventional cotton seed cake along with other farm produced fodders = 1890 kgs

2. Milk yield per animal per lactation with new cattle feed along with the other farm produced fodders = 1957.50 kgs
3. Price of milk = Rs.5/kg
4. Price of cotton seed cake = Rs.4.50/kg
5. Price of new cattle feed = Rs.3.50/kg
6. Total quantity of cotton seed cake fed per lactation = 1080 kg
7. Total quantity of cattle feed fed per lactation = 945 kg
8. Labour cost of feeding one kg of feed = Rs.0.25
9. Labour cost of milking one kg of milk = Rs.0.75

Table 6.1 Partial budget for substituting cotton seed cake with cattle feed.

Financial Losses		Financial gains
1. New Costs		3. Costs Saved
a)	Cost of cattle feed: 945X3.50 = Rs.3307.50	a) Cost of cotton seed cake: 1080X4.50 = Rs.4860.00
b)	Labour cost of feeding cattle feed: 945X0.25 = 236.25	b) Labour cost of feeding cotton seed cake: 1080X0.25 = Rs.270.00
c)	Labour cost of milking 1957x0.75 = RS.1467.75	c) Labour cost of milking while feeding cattle feed: feeding cattle seed cake; 1890x0.75 = Rs.270.00
d)	Sub Total (a+b+c)Rs.5011.5	Sub Total (a+b+c)Rs.6547.50

2.	Revenue foregone	4. New Revenue.
e)	Value of milk produced while feeding cotton seed cake 1890X5 = Rs.9450.00	Value of milk produced while feeding cattle feed: 1957.50X5 = Rs.9787.50

Total cost (1+2) = Rs.14461.5 Total Gains (3+4)= Rs.16335.00
Change in net income (Total cost - total gains) 16335-14461.50
= Rs.1873.12

Decision: substitute cotton seed cake with cattle feed.

The Enterprise Budget

The enterprise budget is concerned with the analysis of individual crop or livestock activities in the farm plan. Tese are used to judge the profitability of alternative enterprises, and also to compare the profitability of existing and proposed enterprises. Various types of data are required for budgeting an enterprise, i.e., inputs used, yield per acre or per animal, and prices of inputs and outputs.

In estimating the returns from an agricultural enterprise or a production system, an important distinction is drawn between variable and fixed cost. The variable costs are those costs which are specific to an enterprise and vary with the scale of operatiopn. Another way of appreciating the significance of this definition is that the variable costs should completely be attributable to the presence of an enterprise on the farm. For instance, in the production of milk, cost items such as fodder, concentrates, etc., make up variable costs since they are paid only if the milk is produced. Normally, variable costs increase with the intensity of inputs for a particular enterprise.

The fixed costs, on the other hand, are those cost items which can not be assigned directly to the operation of an enterprise; that is, they must be defrayed whether a particular enterprise is operated or not for the current production cycle. Fixed costs do not vary with the size or intensity of a particular enterprise. For milk production, such items are interest on shed and space, and depreciation on shed and some family labor. On a farm where several enterprises are in operation, it is very difficult to allocate fixed costs among enterprises.

The market value of the produce and or of any by-product of a production system is defined as its output: Normally this value is based on prices at the farm (village prices adjusted for local transport costs). When the variable costs are subtracted from the estimate of the output, the remainder is called the gross margin. This difference between the output and the variable costs, usually calculated on per acre or per head basis, is a very useful measure of the performance of an enterprise and the contribution that it can make to farm income or profitability.

The concept of gross margin is simple and easy to understand and can be used in many ways. It should be noted that the gross margin is not a profit measure. It is simply an estimate of the potential contribution that an individual enterprise can make to farm profit. The gross margins do vary from farm to farm and year to year due to varying influence of factors like soil, breed, market conditions, prices and the difference in farming practices. It is, therefore, wise that such factors particularly prices and techniques of production should be taken into account while using the concept of gross margins.

In working out the gross margins for livestock enterprises, an underlying assumption is that the calculations refer to a 'steady state' enterprise; that is, a productive animal is being kept in a herd where births (including male/female calf ratio), deaths, culls and replacements are consistent with the maintenance of a certain number of productive animals in a given year. For this reason, it is convenient to assume a herd size of 100, as any fraction derived from this number can readily be used for estimating costs and returns on a per head basis.

Let us consider Sahiwal cow enterprise (Table 6.2). The total output is derived from five elements which are milk, male and female calves, heifers, culls and manure. The proportional contributions of the two types of calves to output allow for mortalities amongst them before being sold. The culling rate of 7 percent is related to replacements coming to the herd at 12 percent as shown in the cost sections of the enterprise budget. Ideally, if there are no deaths or replacements then the two rates should be the same: but a higher replacement rate compensates for replacement mortality.

The working capital tied up in the production of one animal is assumed to be equivalent to its average value (that is half of the sum of replacement cost and the culling price) the interest charge is 12.5 percent of this sum.

Table: 6.2 Enterprise Budget For Livestocvk

Enterprise: Sahiwal Cow:

A.	Output		Rate/Unit in rupees	Amount in rupees
	a)	Milk 2250 liter	4.5	10125
	b)	Calf 0.39	700	273
	c)	Heifer 0.29	2400	696
	d)	Culls 0.07	6000	420
	e)	Manure 160 Maunds	5	800
	f)	Total Output (sum of a to e)		12341
B.	Variable costs			
	a)	Fodder		
		Green 420 Maunds	8	3360
		Dry 90 Maunds	12	1080
	b)	Concentrate 25 Maunds	100	2500
	c)	Vet. & Medicine		100
	d)	Bull Service Charge		50
	e)	Replacement 12%	140000	1680
	f)	Interest @ 12.5% per annum on average value	-	1250
	g)	Labor (1/2 of total required)	-	1440
	f)	Total Variable costs (Sum of a to g)	-	11460
C.	Gross margin per head (A-B) 881			

The fixed cost items include the remaining half of the labor requirements (Rs.1440), equipment cost (Rs.192) and interest on shed and space plus depreciation on shed (Rs.375). Thus the total cost of keeping a Sahiwal cow would be (Rs.13467) and the resulting per head net income would be (Rs.1153).

The return to labor is calculated by adding the labor cost back to the net income and then dividing the resulting sum by the labor cost. This comes to Rs.22 per day. The remaining two measures of performance are returns to feed cost in percent and returns to livestock capital in percent. The return to feed cost are estimated by adding the feed costs back to the net income and then dividing the resulting sum by the feed costs before multiplying by 100. It is within as 83 percent [(-1153+6940)/6940]*100. Similarly the estimate of the returns to livestock capital is obtained by adding the interest charge on the average value of the animal to the net income and dividing the sum by the average value of the animal before multiplying by 100. The result can be written as [(-1153+ 1250)/ 100000]*100=1%.

COMPLETE BUDGET OR WHOLE FARM BUDGET

Complete budgeting refers to making out a plan for the whole farm or for all decisions of one enterprise. Complete budgeting considers all the enterprises and determines the prospective expenses and income resulting from a complete change in the choice and combination of farm enterprises, and a

complete reallocation of farm resources. The major objective of complete budgeting is to make the most efficient use of available resources that would in turn maxmize the income.

Following steps are generally involved in developing an optimum plan with this budgeting technique.

1. **Inventory of resources**

Write down the amount of resources available on the farm such as land, labour, water, building, milch and draught animals, goats, sheep, camel, horses, donkeys, machinery and other capital, etc. One should walk around all over the farm and make a map. Soil of each acre may be identified such as sandy loam, clay loam etc, which would help the agronomists and others scientits in making recommendations to the farm planner. The topograply of the land may also be noted as it defines the limits of growing different crops. One should also see the total availability of family labor, permanent hired labour and casual hired labor in different seasons. Information on total availability of water in different months is also very important in deciding the total acreage that can be placed under different crops. Similarly, one should know the amount of capital that is available and how much can be borrowed from various sources.

2. **Information on input output relationships**

Farm planner should collect all relevant information from various reports published by various experimental research

stations to learn about the available new and improved technologies and other improved practices, and various input-output coefficients related to the amount of each resource required to produce each product. Information from records and surveys can be used to derive the input-output coefficients for farm enterprises since a particular product can be produced using any of the different processes. Therefore, one should always select the most efficient technology.

3. Identification of Prices to be Used

For this purpose we need to know the prices of various products and inputs, which are never stable. The budgeting process is carried on to estimate the future process. Hence, the prices to be used in a farm plan must be the expected future prices, which can be forecast. There are various methods of forecasting prices. It is however beyond the scope of this book to discuss these methods. Farm planners can refer to the past to obtain normal prices; an average of three, four or five years is often useful. Future prices must also be based on the trends of past few years' prices, future expectations, government policies, changes in technology, etc.

4. Determining the Relative Profitability of Enterprises

A farmer should prepare an enterprise budget for each of his crop/livestock activity using data and information from his own records. Farm planner must also make enterprise budgets for all such crop/livestock activities that may be potential

enterprises to increase his income. The enterprise budgets show the net income associated with each enterprise. It is obtained by deducting variable cash expenses from gross income. It may be noted that profitability per unit of resource should always be calculated for a factor that is scarce. If land is the scarcest factor, especially where the tubewells are installed or sufficient water from other sources is available, one should see the profitability of various crops on per acre basis; but in situations where water is the real scarest factor, profitability of various crop enterprises may be determined on the basis of profit per acre inch of water. Similarly, in livestock enterprises one can see the profitability from the point of view of labor, feed and livestock capital. Finally, one can rank these crop enterprises according to their profits depending upon the scarest factor.

5. Examining the Existing Farm Plan and Identification of Handicaps and Shortcomings

In this step, one should diagnose the shortcomings and weaknesses in the present organization and operation of the farm. The extent of use of each resource and the level of output of each enterprise must also be examined in order to ensure the optimum use of the farm resources. One can see how the farm crops yield per acre and livestock production per animal unit compare with the prevailing standards. However the varieties of crops and breeds of animals being raised at the farm are suitable and whether the fertilization rates, present methods of fertilization and feeding rates meet the recommendations of the scientists, etc. Further, it is also ascertained whether the present

combination of enterprises allow full use of resources. It requires information about the costs and returns of various products, i.e., gross income, variable costs and net returns to fixed resources for each enterprise. Such an analysis will point out to the planner various weak links in the existing plan and will provide the guidelines what a farmer should grow in the alternative plan in order to effect the needed improvements in the existing returns.

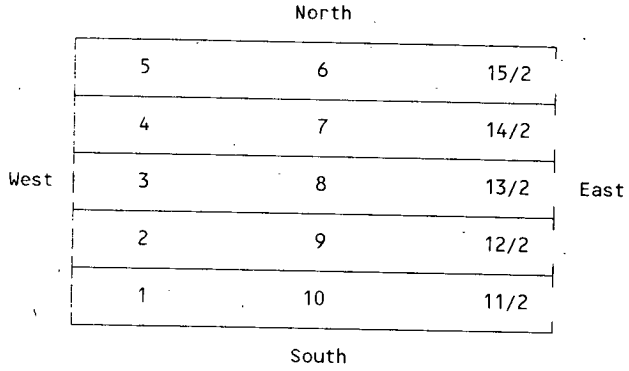
6. Preparation of Alternative Plans

Alternative plans should be developed by considering resource restrictions, weaknesses of existing organization and possibilities of introducting new technologies and new enterprises. More resources are allocated for the production of those farm products for which net returns (obtained by deducting variable costs from gross income) are higher. Sum of all net incomes from various enterprises, provides overall net farm income. One can then compare the potential profit of two or more plans and the plan promising highest returns to fixed factors within the resource restrictions is finally selected.

Various steps involved in the process of farm planning and budgeting are illustrated below for a typical 12.5 acre farm in Faisalabad District. These are: I) farm map; II) inventory of farm resources; III) input-output relationship and relative profitability; V) handicaps and shortcomings in the existing plan; and VI) preparation of alternative plans.

I Farm Map

Sketch of the farm is indicated below:



II. Inventory of farm Resources.

Details of farm resources are given below:

1. Land Holding:

i) Land owned = 12.50 acres
ii) Number of acres rented in =
iii) Number of acres rented out =
iv) Number of acres share cropped in =
v) Number of acres share cropped out = -
vi) Operational holding = (i + ii + iv)-(iii + v) = 12.50 acre

The soil is clay loam. Land is well drained and levelled. It is fit for cultivation of sugarcane, maize, rice, cotton, wheat, and Kharif and Rabi fodders.

2. **Land Use**

The farmer allocates his land to various crops as under:

Kharif Crops

Sugarcane	1.50 acres
Cotton	2.50 acres
Rice	0.50 acres
Maize	1.00 acres
Kharif Fodder	1.25 acres
Sub total in kharif	6.75 acres

Rabi Crops

Wheat	7.50 acres
Rapeseed & mustard	
Burseem	2.25 acres
Rabi crops total	9.75 acres

Grand total	**16.50 acres**
Cropping Intensity	$\frac{16.50}{12.50} \times 100$
	= **132 percent**

3. **Farm Labor**

Availability of family male labor = 1.6 units
Availability of family female labor = 1 unit

Permanent hired labor is available but the cost of hiring such labor is quite high, i.e., Rs.10,000/year. Casual hired labor

is available in general but the farmers face labour shortage during the peak periods like harvesting of wheat, etc.

4. **Animal Strength**

Type of Livestock	Number
i) Nili Ravi	1
ii) Average milking buffalo	1
iii) Average milking cow	1
iv) Sheep	3
v) Beetal goat	2
vi) Taddy goat	5

5. **Farm Machinery and Equipment**

Machinery/Equipment	Number	Price/unit Price/Unit
i) Tractor	-	
ii) Cultivator	-	
iii) Trolley	-	
iv) Thresher	-	
v) Bullock Cart	1	3000/-
vi) Sprayer	-	-
vii) Kharif drill	-	-
viii) Rabi drill	-	-
ix) Other	-	-

6. **Buildings**

Type of Building	Size
i) Shed for animals	14' X 30'
ii) Tractor shed	-
iii) Store for grains	-
iv) Other specify	-

7. Working Capital

Farmer possesses reasionably sufficient owned and borrowed funds to invest in farm business.

8. Irrigation

The main source of irrigation is canal water. The underground water is not fit for irrigation. Therefore, tubewell water cannot be used to supplement the canal supplies. The availability of canal water during various month of the year are given below:

Month	Total water availability in acre inches
January	20
February	30
March	30
April	36
May	36
June	25
July	30
August	36
September	36
October	36
November	30
December	30

9. Management

The farmer is both a manager and a labourer at his farm. He possesses long experience in growing crops and rearing animals.

III and IV. Input - Output Relationship and Relative Profitability

It is assumed that the existing crop enterprises at the farm have optimum combination and are, therefore, ignored in further discussion. The input-output coefficients for livestock activities are assumed to be the same as already indicated under the enterprise budget. However, these coefficients may differ widely at various farms. Profitability of various livestock enterprises is indicated in (Table 6.3).

On the basis of profitability analysis in terms of gross margin per head, it can be seen that maintenance of Nili Ravi buffalo is highly rewarding (Rs.2009) followed by average milking cow (Rs.735), average milking buffalo (Rs.671), beetal goat (Rs.361) teddy goat (Rs. 247) and sheep (Rs.128). Total gross margin under the existing plan amounted to Rs.5756 (Table 6.4).

Feed is considered to be the most important limiting factor in livestock sector in Pakistan. Therefore, gross margin per rupee of feed fed to various categories of livestock was estimated. The results obtained are presented in Table 6.5. These show that gross margin per rupee of feed was maximum for the beetal goat (Rs.3.61) followed by sheep (Rs.2.13), teddy goat (Rs.1.37) average milking cow (Rs.0.42), Nili Ravi buffalo (Rs.0.27) and an average milking buffalo (Rs.0.18).

It may be noted that feed is not a limiting factor at many large farms. The scarcest factor at such farms is the farm labour; therefore, there is a need to determine the gross margin per labour day. Gross margin per labour day is also estimated and

presented in Table 6.6. It shows that gross margin per labor day is the highest for teddy goat followed by Nili Ravi buffalo and beetal goat It is the lowest for an average milking buffalo.

V. Handicaps and shortcomings in the existing plan

Following weaknesses can be identified in the existing plan of livestock production (Table 6.7).

i) As already mentioned, feed is the most important constraint in our livestock sector. Gross margin analysis done on the basis of feed expenditure suggests that the farmer should produce maximum possible number of beetal goat, followed by sheep and teddy goat. In the present plan there is a need to reduce the number of milking buffalo, cow and teddy goat. The number of beetal goats must be increased to improve the gross margin of the livestock enterprises.

ii) The existing milk yield rates are quite low than the potential yields which could be obtained by applying improved animal husbandry practices.

iii) Under the existing plan, the farmer is feeding very low quantities of concentrates to the dairy animals and no concentrates are being fed to sheep and goat.

VI. Preparation of Alternative Plans

The enterprises with highest level of gross margins per rupee of feed expense should be selected and the number of

heads should be increaseed. There could however be some constraints in the way of further expansion. In that situation, the second best enterprise should be selected and tried to optimize, until a constraint prevents further expansion. This procedure should be continued until all the feed available has been optimally allocated.

Availability of total feed is given in Table 6.8. Alternative plans are prepared keeping in view the existing weaknesses, feed availability restrictions and possibilities of incorporating modern technologies (Table 6.9). In plan I beetal goats and teddy goats have been increased, while buffaloes and cows have been eliminated. Output rates of expanded enterprises have increased due to better feeding and improved animal husbandry practices. Consequently, gross margin associated with each enterprise included in Plan I is higher as compared to the original plan. We have developed here only two alternative plans. However, one can make still more plans and can select a plan which promise the highest income to fixed farm factors.

Table: 6.3 Profitability of livestock enterprises

6.3.1 Profitability of Nili Ravi Buffalo
(Per Buffalo Per Year)

Particulars	Unit	Quantity	Rate	Amount
				(Rs.)
Produce				
Milk	Litres	2200	5	11000
Calf	Heads	0.35	800	280
Heifer	Heads	0.26	2500	650
Culls	Heads	0.07	7000	490
Manure	40 Kgs	180	5	900
Output				13320
Costs				
Fodder				
Green	40 Kgs	480	8	3840
dry -	40 Kgs	90	12	1080
Concentrate	40 Kgs	25	100	2500
Vet. & medicine			100	100
Bull service charge			50	50
Replacement @ 12%	Heads	0.12	18000	2160
Interest @ 12.5% per annum on average value				1563
Labor	Days	90	36	3240
Equipment costs			192	192
Interest on shed & space + Depreciation on shed			460	460
Variable Costs				11311
Total Cost				15185
Gross Margin	(Rs.)			2009
Net Income	(Rs.)			-1865
Return to:				
Labor	(Rs./day)			15
Feed Cost	(%)			15
Livestock Capital	(%)			-15

6.3.2 Profitability of Average Milking Buffalo

(Per Buffalo Per Year)

Particulars	Unit	Quantity	Rate	Amount
				(Rs.)
Produce				
Milk	Litres	1400	5	7000
Calf	Heads	0.24	550	132
Heifer	Heads	0.22	2100	462
Culls	Heads	0.05	6000	300
Manure	40 Kgs	120	5	600
Output				8494
Costs				
Fodder				
Green	40 Kgs	300	8	2400
dry	40 Kgs	45	12	540
Concentrate	40 Kgs	8	100	800
Vet. & medicine			25	25
Bull service charge			50	50
Replacement @ 12%	Heads	0.12	13000	1560
Interest @ 12.5% per annum on average value				1188
Labor	Days	70	36	2520
Equipment costs			128	128
Interest on shed & space + depreciation on shed			222	222
Variable Costs				7823
Total Cost				9433
Gross Margin/Heads		(Rs.)		671
Net Income/Heads		(Rs.)		-939
Return to:				
Labor		(Rs./day)		23
Feed Cost		(%)		75
Livestock Capital		(%)		-10

6.3.3 Profitability of Sahiwal Cow
(Per Cow Per Year)

Particulars	Unit	Quantity	Rate	Amount
				(Rs.)
Produce				
Milk	Litres	2250	5	10125
Calf	Heads	0.39	700	273
Heifer	Heads	0.29	2400	696
Culls	Heads	0.07	6000	420
Manure	40 Kgs	160	5	800
Output				12314
Costs				
Fodder				
Green	40 Kgs	420	8	3360
dry	40 Kgs	90	12	1080
Concentrate	40 Kgs	25	100	2500
Vet. & medicine			100	100
Bull service charge			50	50
Replacement @ 12%	Heads	0.12	14000	1680
Interest @ 12.5% per annum on average value				1250
Labor	Days	80	36	2880
Equipment costs			192	192
Interest on shed & space + depreciation on shed			375	375
	Variable Costs			11460
	Total Cost			13467
Gross Margin/Heads		(Rs.)		854
Net Income/Heads		(Rs.)		-1153
Return to:				
Labor		(Rs./day)		22
Feed Cost		(%)		83
Livestock Capital		(%)		1

6.3.4 Profitability of Average Milking Cow

(Per Cow Per Year)

Particulars	Unit	Quantity	Rate	Amount
				(Rs.)
Produce				
Milk	Litres	860	4.5	3870
Calf	Heads	0.31	450	140
Heifer	Heads	0.25	2500	625
Culls	Heads	0.07	4000	280
Manure	40 Kgs	80	5	400
Output				5315
Costs				
Fodder				
Green	40 Kgs	130	8	1040
dry	40 Kgs	20	12	240
Concentrate	40 Kgs	4.5	100	450
Vet. & medicine			30	30
Bull service charge			30	30
Replacement @ 12%	Heads	0.12	8000	960
Interest @ 12.5% per annum on average value				750
Labor	Days	60	36	2160
Equipment costs			128	128
Interest on shed & space + depreciation on shed			167	167
		Variable Costs		4580
		Total Cost		5955
Gross Margin/Heads		(Rs.)		735
Net Income/Heads		(Rs.)		-641
Return to:				
Labor		(Rs./day)		25
Feed Cost		(%)		63
Livestock Capital		(%)		-11

6.3.5 Profitability of Beef Cattle

(Per Buffalo Per Year)

Particulars	Unit	Quantity	Rate	Amount
				(Rs.)
Produce				
12 month old animal			2500	2500
Manure	40 kgs	40	5	200
Output				2700
Costs				
Fodder				
Green	40 kgs	140	8	1120
dry Fodder	40 kgs	70	12	840
Vet. & medicine			22	22
Calf			730	730
Interest @ 12.5% per annum on average value				202
Labor	Days	29	36	1044
Equipment costs			96	96
Interest on shed & space + depreciation on shed			111	111
	Variable Costs			3436
	Total Cost			4165
Gross Margin/Heads	(Rs.)			-736
Net Income/Heads	(Rs.)			-1465
Return to:				
Labor	(Rs./day)			-15
Feed Cost	(%)			25
Livestock Capital	(%)			-346

6.3.6 Profitability of Meat Buffalo

(Per Head Per Year)

Particulars	Unit	Quantity	Rate	Amount
				(Rs.)
Produce				
12 months old animal			2600	2600
Manure	40 kgs	45	5	225
Output				2825
Costs				
Fodder				
Green	40 Kgs	155	8	1240
dry Fodder	40 Kgs	75	12	900
Vet. & medicine	22	22		
Calf			840	840
Interest @ 12.5% per annum on average value				215
Labor	Days	20	36	720
Equipment costs			96	96
Interest on shed & space + depreciation on shed			111	111
	Variable Costs			3577
	Total Cost			4144
Gross Margin/Heads	(Rs.)			-752
Net Income/Heads	(Rs.)			-1319
Return to:				
Labor	(Rs./day)			-30
Feed Cost	(%)			38
Livestock Capital	(%)			-64

6.3.7 Profitability of Sheep

(Per Head Per Year)

Particulars	Unit	Quantity	Rate	Amount
				(Rs.)
Produce				
Wool	kg	1.3	32	40
Youngstock	Heads	0.97	450	437
Culls	Heads	0.09	400	36
Manure	40 kgs	3.8	5	19
Output				531
Costs				
Grazing	Acres	0.06	1000	60
Vet. & medicine			3	3
Ram service charge			10	10
Replacement @ 15%	Heads	0.15	600	90
Miscellaneous			15	15
Interest @ 12.5% per annum on average value			63	63
Labor for grazing	Days	9	36	324
Interest on shed & space + depreciation on shed			24	24
	Variable Costs			403
	Total Cost			589
Gross Margin/Heads	(Rs.)			128
Net Income/Heads	(Rs.)			-58
Return to:				
Labor	(Rs./day)			30
Feed Cost	(%)			4
Livestock Capital	(%)			1

6.2.8 Profitability of Beetal Goat

(Per Head Per Year)

Particulars	Unit	Quantity	Rate	Amount
				(Rs.)
Produce				
Milk	kg	40	4	160
Youngstock	Heads	1.7	800	1368
Culls	Heads	0.1	1200	120
Manure	40 Kgs	4	5	20
Output				1508
Costs				
Grazing	Acres	0.1	200	20
Green fodder	40 Kgs	20	4	80
Vet. & medicine			3	3
Buck service charge			28	28
Replacement @ 30%	Heads	0.3	800	240
Miscellaneous			15	15
Interest @ 12.5% per annum on average value				125
Labor of grazing	Days	8	36	288
General Labor		9	36	324
Interest on shed & space + depreciation on shed			24	24
	Variable Costs			511
	Total Cost			1147
Gross Margin/Heads	(Rs.)			997
Net Income/Heads	(Rs.)			361
Return to:				
Labor	(Rs./day)			57
Feed Cost	(%)			461
Livestock Capital	(%)			36

6.3.9 Profitability of Teddy Goat

(Per Buffalo Per Year)

Particulars	Unit	Quantity	Rate	Amount
				(Rs.)
Produce				
Youngstock	Heads	2.18	320	698
Culls	Heads	0.28	320	90
Manure	40 kgs	2.5	5	13
Output				800
Costs				
Fodder	40 kgs	45	4	180
Vet. & medicine			3	3
Buck service charge			28	28
Replacement @ 30%	Heads	0.30	400	120
Miscellaneous			15	15
Interest @ 12.5% per annum on average value				45
Labor	Days	9	36	324
Interest on shed & space + depreciation on shed			24	24
	Variable Costs			553
	Total Cost			739
Gross Margin/Heads	(Rs.)			247
Net Income/Heads	(Rs.)			60
Return to:				
Labor	(Rs./day)			43
Feed Cost	(%)			133
Livestock Capital	(%)			17

6.3.10 Profitability of Broiler Production

(1000 Broilers Kept for 50 Days)

Particulars	Unit	Quantity	Rate	Amount
				(Rs.)
Produce				
Birds marketed (Live Weight)	kg	1400	27	37800
Empty feed bags	No	65	2	130
Litter	Truck	0.2	474	71
OutPut				38001
Costs				
Day old chicks	No	1000	12	12000
Feed on IV	Bag	25	286	7150
Fedd no V	Bag	40	281	11240
Glucose/maize			48	48
Vaccination etc			232	232
Fuel			488	488
Brooding			678	678
Miscellaneous (med. & litter)			1210	1210
Interest @ 12% per annum for 50 days				573
Labor			866	866
Depreciation on buildings & equipment			1434	1434
	Variable Costs			34052
	Total Cost			35919
	Prod. cost/kg live wt			26
Gross Margin/Heads	(Rs.)			3949
Net Income/Heads	(Rs.)			2082
Return to:				1
Labor	(Rs./day)			
Feed Cost	(%)			119
Livestock Capital	(%)			8
Fixed Capital	(%)			2

6.3.11 Profitability of Egg Production

(1000 Layer Kept for 60 Weeks)

Particulars	Unit	Quantity	Rate	Amount
				(Rs.)
Produce				
Egg (360 per crate)	Crates	685	423	289755
Culled birds	No	850	30	25500
Poultry manure	Truck	2	305	644
Empty feed bags	No	510	2.9	1479
Output				317378
Costs				
Day old chicks	No	1000	15	14600
Layer's ration	Bags	700	225	157500
Vaccination @ Rs 2.6/bird				3.23200
Rice hus @ Rs 1.6/bird				2.02000
Fuel/electricty @ Rs 5.4/bird				6.66600
Interest @ 12.5% per year incl. average value of birds				28154
Labor @ Rs 9.6/bird			11.7	11700
Rent @ Rs 6.5/bird			7.9	7900
Depreciation @ Rs 2.5/bird			3.2	3200
	Variable Costs			217904
	Total Cost			234854
	Production cost/crate			343
Gross Margin		(Rs.)		99474
Net Income		(Rs.)		82524
Net Income/crate of eggs		(Rs)		120
Returns to:				
Labor		(Rs./day)		282
Working Capital		(%)		50
Fixed Capital		(%)		133

Table 6.4 Profitability of Livestock Enterprises (Rs. Per head).

Item	Nili Ravi	Average milking buffalo	Average milking cow	Sheep	Beetal	Teddy goat
a)Gross income	13320	8494	5315	531	1508	800
b)Variable cost	11311	7823	4580	403	1147	553
c) Gross margin (a-b)	2009	671	735	128	361	247

Note: Gross margin from Livestock activities,

$$GI = \Sigma Ai\ Gi$$

Where Gi represents the gross margin from i-th enterprise, Ai shows the number of heads of i-th enterprise. Using this formula, total gross margin is equal to Rs.5756 = (2009 X 1 + 671 X 1 +735 X 1 + 128 X 3 + 361 X 2 + 247 X 5).

Table 6.5 Gross Margin per Rs. of Feed

Enter prise	Gross margin (Rs.)	Feed cost (Rs.)	Gross margins per rupee of feed
Nili Ravi	2009	7420	0.27
Average milking buffalo	671	3440	0.18
Average milking cow	735	1730	0.42
Sheep	128	60	2.13
Beetal goat	361	100	3.61
Teddy goat	247	180	1.37

Table 6.6 Gross Margin per day of Labor from various Livestock enterprises.

Enterprise	Gross margin per head (Rs.)	Labor days	Gross margin per per labor day
Nili Favi	2009	90	22.32
Average milking buffalo	671	70	9.58
Average milking cow	735	60	12.25
Sheep	128	9	14.22
Beetal goat	361	17	21.23
Teddy goat	247	9	27.44

Table 6.7 Existing Livestock Plan.

Livestock category (Rs)	Number of animals	Gross margins	
		Per head	Total (Rs.)
Nili Ravi Buffalo	1	2009	2009
Average milking buffalo	1	671	671
Average milking cow	1	735	735
Sheep	3	128	384
Beetal goat	2	361	722
Teddy goat	5	247	1235

Table 6.8 Total feed consumption under the existing plan

Category of animal	No. of animals	Feed per animal (kgs.)		
		Green fodder	Dry fodder	Concentrate
Nili Ravi Buffalo	1	19200	3600	2009
Average milking buffalo	1	12000	1800	320
Average milking cow	1	5200	800	180
Sheep	3	1825	-	-
Beetal goat	2	2418	-	-
Teddy goat	5	1800	-	-
Total consumption by all animals		55711	6200	1500

Table 6.9 Alternative Livestock Plans

	Plan I			Plan II		
	Numbr of animals	Gross margin per head (Rs)	Gross margin Total (Rs)	Number of animals	Gross margin per head (Rs)	Gross margin Total (Rs)
Nili Ravi Buffalo	0	-	-	1	4000	4000
Average milking buffalo	0	-	-	-	-	-
Average milking cow	0	-	-	-	-	-
Sheep	0	-	-	2	250	500
Beetal goat	20	450	9000	10	450	4500
Teddy goat	4	350	1400	5	350	1750
Total returns to fixed factors		-	10,000	-	-	10,750