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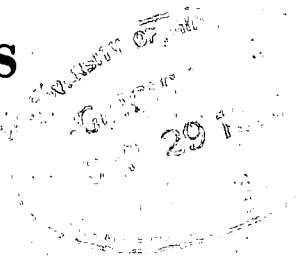

The Economics of Water Supply and Control:

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SOME IMPLICATIONS OF WATER CONTROL IN NORWAY

IN Norway, few farming areas have problems arising from scarcity of water. On the other hand, 20 per cent. of the country's farmland is considered too wet and marshy for efficient farming. Some of what would otherwise be amongst the best farming regions suffer from a high percentage of swampy soil. In addition, most of the land suitable for clearing and cultivation is of a marshy type and requires drainage. Consequently, the problem of drainage is the most important in the context of water control in Norway.

During the last five years, 37,000 hectares of cultivated land—4·5 per cent. of the total cultivated area—was drained. This amounts to about one-fifth of what is required according to the official census. In the same period, approximately 36,000 hectares were drained under land-reclamation projects.

Obviously, the over-all figure covers a great variation from farm to farm as well as between regions. While areas devoted mainly to grassland farming exhibit only minor drainage activity, in other regions the area of drained tillage land is increasing at a rate of 2·5 per cent. or more per year. Even though this rate in most cases coincides with a relatively high drainage requirement, the speed is considerable. In general, the areas where drainage seems to be proceeding most rapidly, correspond with what are regarded as our most advanced farm districts.

A well-known Norwegian saying is: 'A poor farmer is primarily interested in his house, next comes the barn and finally the drainage; while a good farmer directs his attention in the opposite sequence.' The statistics from recent years confirm that the saying may have some truth in it. (In earlier periods, farmers tended to expand their farm activities by reclamation rather than by improvement of existing cultivated land.)

Drainage may have various effects on the farm. The most obvious effect is on yield per acre. An increase in yield may be due to better physical condition of the soil and to better utilization of applied fertilizers. Or it may be a result from more correct timing of the productive operations. In a country with a short growing season, it is of importance to prepare the land to permit as early a seeding as

possible. Pushing matters to extremes, it is said that a day in spring is worth a week in autumn. The time feature is of greatest significance in the grain-growing counties, and particularly for spring wheat and oats. Normally, the growing period has to be fully used to secure satisfactory crops. As a well-drained soil will dry up early in spring, the consequences of drainage may easily be recognized at harvest time.

Apart from the influence on yield there is another worth-while effect of drainage. The combine harvester can be used to a greater extent than before—firstly, because the crops ripen in a period normally dry enough to justify combining, and secondly because the soil can better carry heavy equipment.

This leads to consideration of the change in labour use and its seasonal distribution. By drainage of moist land, for example in clay soil areas, the period within which spring cultivating can be pursued is lengthened in many instances by two or three weeks. This provides a more flexible labour distribution during summer-time, and a reduced labour peak in autumn. A fixed labour force, which occurs most frequently on Norwegian farms, may then be able to produce more. This applies mainly to medium-sized and large farms.

In addition to the labour distribution effect, a saving of working time is realized by drainage. This applies particularly to heavy soil, where many farmers claim a 20–25 per cent. reduction in the soil cultivating work. As indicated for combine harvesting of grain, more efficient equipment can in certain cases be used on well-drained land, thus further increasing the labour efficiency.

Turning back to the increase in yield, some increase in labour requirement per hectare may occur, chiefly on crops where manual or semi-manual methods are practised for harvesting. But if, on the other hand, we consider the production in tons or feed units per man hour, the labour productivity is increased with the higher yields. This labour productivity consequence of increased yields is of greatest interest on bigger farms, where labour is often the limiting factor of production.

On most farms, however, the land area is the major restricting factor. And it is on just such farms that drainage, as a main item in cultivating new land, is of utmost importance for economic production and welfare. As has been pointed out, the census also shows that farmers generally evaluate the reclamation of land as a key point in their investment policy. Additional land does not usually entail an addition in labour and other fixed costs, and the increase in

total farm production therefore contributes considerably to net earnings. The increase in productivity is secured by an expansion in acreage using the existing labour force and techniques, and because more efficient machinery can more easily be adopted. On the majority of small Norwegian farms, where a certain degree of unemployment prevails, the use of family labour in clearing new land greatly reduces the reclamation cost. The profitability of this type of investment on small farms normally justifies its being given top priority.

Other features connected with the level of water control on a farm are flexibility and uncertainty. As flexibility and uncertainty are even more difficult to quantify than the factors previously dealt with, the discussion will be confined to a few remarks. A well-drained farm provides greater opportunities for varying the cropping system in accordance with the prevailing economic environment. For example, part of a wet farm must be permanently devoted to meadow or pasture, while the price situation may call for pork or eggs. Flexibility contributes to a diminished uncertainty. Furthermore, we know from experience that yield per hectare shows less variation between years when an appropriate water supply is available.

The key points in evaluating the economy of drainage are:

Yield.

Labour use and distribution.

Labour productivity through improved utilization of the fixed supply of labour and other resources.

The feasibility of using modern machinery.

Flexibility and uncertainty.

To make a correct decision within the context of the total farm economy, the return from alternative employment of resources must also be considered. Unfortunately, there are not sufficient basic data available for the carrying out of a well-founded and complete analysis to determine the best course of action. Experiments in this field are few, and those pursued deal mainly with technical details and are of limited use for economic evaluation. Drainage research, with few exceptions, is restricted to land such that everybody would recommend drainage as a condition of farming at all. Minor differences in the most frequently used ditch systems, in most cases, seem to have little influence on yield and other aspects. The least expensive alternative will then automatically be the best one. For more questionable land, the basic data for economic evaluation are very few.

Even if an increased yield is recorded in the few experiments, the results are difficult to apply to situations with land of doubtful water content. Land classification suffers from a general shortage of sufficiently sensitive indicators of water supply. In practice, however, drainage is often recommended wherever there is any doubt.

Whether judgement or estimates are to be applied, it facilitates the appraisal if the various factors can be put together in a total budget. The Scandinavian Agricultural Research Workers' Association suggests a formula for the calculation of the expected annual income from a drainage project:

$$y=(N+L)-\left(C\frac{a}{100}+M\right)+X$$

—where y = annual income,
N = net value of increase in yield,
L = change in labour cost,
C = capital invested,
a = interest and depreciation (annual rate),
M = annual maintenance cost,
X = residual benefits or losses.

The net value of the increase in yield must be ascertained in each particular case. A sale, replacement or utilization value can be used. The change in labour consumption may be a direct change in cost if hired casual labour is in question. With a fixed labour force, no direct cost is relevant, but eventual lost or increased earnings in alternative employments should be considered. Also, for the interest rate the opportunity cost may be the most relevant. Alternatively, the interest on capital may be left out as a cost and included in the income residual. The choice of amortization period depends firstly on the durability of the project, but secondly on how soon the capital will be required for other uses. Residual benefits or losses originating from other aspects mentioned in the general discussion can be included at this stage. Complete budgeting is therefore a rather complicated process.

A more simple but incomplete indication of expected benefits is derived from a computation of the required value of increased yield to cover normal interest and depreciation of invested capital. Assuming, for example, an investment of kr. 2,000 per hectare for drainage, an amortization period of fifty years, and a 3 per cent. rate of interest, the annuity formula can be applied:

$$\text{Annual cost} = \frac{2000 \cdot 1{\cdot}03^{50} \cdot 0{\cdot}03}{1{\cdot}03^{50} - 1} = \text{kr. } 77{\cdot}80 \text{ per hectare.}$$

By omitting factors other than yield, and assuming a price or value of kr. 0·50 per feed unit, an extra yield of 150–160 feed units per hectare is necessary to cover basic costs. Maintenance cost, normally reckoned at 0·5 per cent. per annum, can readily be introduced in this computation. If we insert a shorter period and/or a higher interest rate, the required return per year will, of course, be greater. According to prevailing experimental data on land classified as dubious with respect to advantages of drainage, an average increase in yield amounting to 300–500 feed units per hectare is suggested as easily achievable.

At present, data to quantify the other economic features of drainage are hardly available. A few observations on labour exist, but are not sufficient to satisfy the requirements of a thorough analysis. On the other hand, an approach can be made to ascertain the global effect of drainage on farming. A considerable deficiency of this approach is, of course, the number of confounding factors. A random sample of 100 farms of approximately equal size and operated upon the same system was selected. The sample was designed to secure the greatest possible homogeneity in respects other than drainage level. The farms were grouped as poor, fair, and well drained by judgement based on certain criteria. Farms on which only 0–33 per cent. of the area could be rated well drained were classified as 'poor', farms with 34–67 per cent. well-drained land were put in the 'fair' group, while the rest were considered well drained.

The figures for yield and income were as follows (yields in kilogrammes per hectare):

TABLE 1

Crop	*Drainage*		
	Good	*Fair*	*Poor*
Wheat	1,990	1,760	1,680
Barley	2,410	1,990	2,010
Oats	2,430	2,250	1,980
Potatoes	22,630	23,500	22,330
Turnip	49,470	45,750	47,840
Hay	5,580	5,090	4,940
Feed units/ha.	3,000	2,920	2,720
Farm size, ha.	16·9	15·1	14·7
Farm labour income, kr.	11,724	9,999	9,067

A change from poor to fair drainage condition has increased the average yield by 200 units per hectare, while the next step has raised the average yield by another 80 feed units. Compared with previous calculations the increase following an improvement from poor to medium drainage should certainly cover the extra cost. According to the earlier suggested requirement of 150–160 feed units, the 80-feed unit increase from fair to well-drained soil should, on the contrary, be too small to justify the investment. But here the farm income figures do not agree. The outcome must be considered an effect of disturbing factors, or aspects other than yield are of importance in evaluating the profitability of drainage. Incidently, it is likely that the general level of management is correlated with the level of water control, thus confounding the results.

As expected, the table indicates that various crops have different sensitivity to surplus water. But even if the sample shows significant differences in yield between drainage stages for some of the crops, a greater variation could be anticipated. That is particularly the case with potatoes and turnips. Obviously, the practical farmer puts his water-sensitive crops on his dry land, consequently minimizing differences that would otherwise occur. The flexibility feature applies to this directed action.

The benefit from operating a farm expanded through land reclamation is readily apparent from the annual farm statistics. The economy of the new cultivation itself is rarely recorded separately. But income figures for farms of different sizes provide evidence for the conclusion that larger gains are obtained as scale of operation increases. There is generally little doubt about the profitability of enlarging the farm, even at considerable investment expense.

To conclude, an improved water control can be considered desirable for the development of Norwegian agriculture. The prevailing investigations, although scarce, indicate that the measures taken to improve drainage in our most advanced farming areas are in accordance with current economic conditions.

Finally, it should be stressed that the government encourages drainage and reclamation by providing subsidies and public funds for loans. The programme is established in recognition of the disparity between potential profitability and financing ability in farming, particularly in a small-farm country such as Norway.