Pig raising in Yugoslavia

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Lucijan KRIVEC
Emona Cooperative Complex "Ihan Domzale" - Ljubljana
Yugoslavia

Aleksandar SRECKOVIC
Institute of Animal Production - Novi Sad - Yugoslavia

The development of pig raising in the postwar years in Yugoslavia was closely connected to the development of agriculture and of the entire national economy.

Because of the general underdevelopment of the Yugoslav economy at the end of the war, agriculture, on which 75% of the entire population depended, was also extremely underdeveloped. This underdevelopment was accompanied by an extreme fragmentation of agricultural land, since in 1955 10,100,000 ha of arable land were divided among 2,563,619 farmers (who had an average of 3.52 ha each) and 8,366 state estates (which had an average of 128 ha of arable land each).

This fragmentation was accompanied by an extensive autarkic production with extremely low yields in crop production and with an extensive animal husbandry, especially pigs, where mostly local breeds were exploited. This situation did not change considerably until 1960 because of the priority given to the construction of industries. During that period, in Western countries, intensive pig production and modern slaughtering were developed which helped to finance selection services and test stations. Northern Europe developed intensive pig breeds which were exported all over the world, influencing in this way the intensification of pig production in Southern and Eastern Europe as well.

Yugoslavia, although a socialist country, did not nationalize private farms. Because of this private-property nature of agriculture, the development of public industry was far more encouraged. For this reason, agriculture kept the pre-war productivity of small, underdeveloped farms. At the end of the 1950s, with the increasing number of the non-rural population, and the development of industry, this resulted in a general shortage of food.

Since the transformation of underdeveloped and fragmented agriculture is a long process, a quick increase of production for the market was possible only in the public sector. For this purpose, by combining public estates and by renting agricultural land, large combines were founded to organize modern agricultural production and animal husbandry with young technicians recently graduated from schools.

The construction of new poultry and pig farms, designed to increase the production of meat for the market, started in 1958. The poultry farms were constructed on the basis of Western technologies. For large scale pig farms, a technology did not exist in the world and technological solutions had to be sought and developed at home. Large scale fattening farms, after the model of Western and Eastern countries, were not possible in Yugoslavia because the production of piglets in the private sector did not exceed the needs of the private sector itself. The only possible solution was farms with complete production, from the reproduction of piglets to the sale of fatteners.

Based on this concept, the Ihan pig farm was built in 1959, with a capacity of 18,000 pigs. This was the first big agglomeration of piglets and fatteners in one place and it represented the beginning of industrial pig production in the world.

I - General aspects and evolution of pig production

The task of new, large scale farms was not only to increase production for the market but also to intensify private pig production. For this purpose, Western intensive pig breeds were imported and farms (which became reproduction centres) replaced and fused extensive local breeds with the new breeds throughout Yugoslavia. At the same time, large scale farms propagated modern breeding methods, including intensive nutrition, improved housing, reproduction and health control.

1. Need for organized pig production

Immediately after the construction of public farms, cooperation with the private sector was organized in such a way that combines and cooperatives financed private pig production by investing in rearing of piglets and fatteners for the market. Through such cooperation, the public sector and private breeders, in spite of the extreme fragmentation of private farms, produced almost 42.3% of all pigs in 1984.

With the increase of public cooperative production, meat consumption per inhabitant increased, which can be seen in **Table 2**.

In spite of the development of the public agricultural sector and cooperatives which enabled the increase of meat consumption per inhabitant, we could not be satisfied with the development of the private sector as its arable land continued to be partitioned, whereas, throughout Europe such land was being consolidated, as is shown in **Table 3**.

It shows that since 1955 the arable land of the private sector has been reduced by 10%, while the number of estates and farms has been increased by 108,920, reducing in this way the arable land per farm from 3.52 to 3.05 ha.

At the same time, the arable land of the public sector was increased by purchase and rent of new lots of land, while the number of estates was reduced because of integrations, so that the surface of land per estate increased from 128 to 478 ha.

Because of the above process, the development of private farms in Yugoslavia was difficult, since the possibilities of cooperation with large farms producing for the market were completely exploited.

In the future, it will therefore be necessary to promote the consolidation of land, if we want to reach the European level.

Table 4 shows that even in mountainous Greece, agricultural land is less fragmented than in Yugoslavia.

Out of 14,418,000 pigs slaughtered in 1984, only 5,749,000 were slaughtered in slaughterhouses, which means that 70.2% were slaughtered at home to supply the rural population. This is an obvious sign of underdevelopment of small autarkic private farms which do not produce for the market. In 1984, of 10,809,000 pigs slaughtered in the private sector, only 2,140,000 or 19,8% were slaughtered in slaughterhouses for needs of other inhabitants.

The average weight of slaughtered pigs coming from private breeders is extremely low, only 42.78 kg, because of the slaughter of 4,859 suckling pigs, which is a Yugoslav speciality.

2. Successive steps in organization of pig production

At the same time the public sector, which owned only 10.9% of all breeding sows in Yugoslavia, produced 25.03% of all pigs and 62.8% of pigs for the market. All this proves that the transformation of underdeveloped and fragmented agriculture is a lengthy process. For this reason, the construction of large scale public farms was the only possible alternative in Yugoslavia, if the problem of meat supply of the urban population, which increased from

32.8% in 1948 to 80.1% in 1987, was to be solved.

This is also the reason why large scale pig production started to develop in Yugoslavia. In 1959, large scale pig farms were built, with their own reproduction of piglets, which represented a component part of fattening farms. This was the start of industrial pig production, although at that time the notion of industrial production was extremely simplified. The technology of family farms in Western Europe was adopted, with farms divided into farrowing farms for production of fatteners. With this technology, small scale production was multiplied in large populations, multiplying at the same time production and health problems.

Farm experts soon realized that difficulties were the result of the technological process, which was not adapted to large populations. It was necessary to develop production organization on principles of industrial production, that is a continuous mass production which would take into consideration the fact that this was live production, where animals in individual phases of growth and reproduction required a specific environment and diet.

In 1961, at a symposium in Hamburg on rearing of livestock on modern farms, Dr. Damon Catron from the United States presented the "life cycle swine nutrition" which was studied and developed at the University of Iowa. According to this system, swine nutrition was adapted to requirements of pigs in differents phases of their development and of their biological cycle, respectively, in order to achieve better rearing results and better economic effects.

In the same way that Dr. Catron divided nutrition by production phases in 1961, we had already reorganized the piggeries at the Ihan farm into piggeries for pregnant sows, for farrowing, for rearing and for fattening. In 1962 we added the insemination department and separated the complete rearing as required by the life cycle nutrition system. The division of production into specialized piggeries was necessary because of the size of the population, since continuous production was necessary and the work organization needed to be simplified.

As with nutritive requirements of pigs, which change over the course of their biological cycle, their requirements for housing, which has to provide for comfort, undisturbed life functions, hygiene and health of pigs, also change.

The pig is one of the most fertile domestic animals, which grows quickly and achieves sexual maturity very soon, therefore its physiological conditions change very quickly. Like Dr. Catron, who studied the life cycle of pigs in order to establish the optimal nutrition, we studied requirements of pigs in individual phases of their biological cycle and their behaviour in a certain environment, in order to find optimal housing. The biological cycle was divided into closed production phases, taking into consideration requirements of different categories of pigs and the economics of rearing.

A simple design of specialized pens had, in 1961, enabled the division of the farm in specialized piggeries which we called:

– Insemination house – for sows after weaning, gilts and boars;

– Gestation house – for inseminated and pregnant sows and gilts;

– Farrowing house – for farrowing and rearing of piglets;

– Rearing house – for rearing of weaners; and

– Fattening house – for fattening of fatteners.

By constantly improving pens and equipment, we built new farms and restored the old ones thereby increasing capacities of piggeries and of overall production. Increasing capacity increases the number of operations which cannot be mechanized. The problem of transfers of pigs became even worse, since on large scale farms there were up to 2,500 pigs which had to be transferred daily and which required much manual work and caused additional losses of animals. On many farms this showed how poorly farm space was organized, as far as internal and external transport was concerned. Therefore, we tried to find a solution for farm

space, where the external transport would be moved out of the farm complex while the internal transport – transfers of pigs inside the farm complex – would be abolished. We saw the solution to this problem in a piggery where complete production, from insemination to the sale of fatteners, occured under one roof and where pigs were transferred only inside the piggery.

In a traditional farm, the piggery was the working place of the worker who was specialized for taking care of a certain category of pigs. Because of the numerous advantages of such specialization, we did not want to give it up. By uniting all production phases, preserving at the same time the scope of work of such specialized workers, we would have obtained, with the then technological concept of pens and equipment, enormous combined piggeries.

For this reason we developed a new technological-technical concept of pens, taking into consideration:

– suitability of pens and good exploitation of floor surface in all categories of animals;

– adequate air-conditioning for an increased density of pigs;

– simple distribution of feed and manure removal;

– mass production of equipment and low costs of manufacturing, assembling and maintenance; and

– functional exploitation.

In intensive production the pen is the only life space not only of the fattener but also of the breeding animal. For this reason it was impossible to reduce its space without taking into consideration the biological and ethological requirements of animals. On the basis of many years of studying and observing the behaviour of pigs, we succeeded in designing pens and arranging them by production phases, which by their name and function approach the traditional organization.

II - Herd organization at Ihan

1. Insemination department

The insemination department has to offer:

– optimal conditions for an early appearance of oestrus;

– establishing the optimal time of insemination; and

– intensive ovulation and minimal embryo mortality.

Therefore in the insemination department there are individual and collective pens. Gilts are put into collective pens, whose capacity can be increased or reduced by movable partitions, which have individual feeding places and in which the absolute surface per animal is considerable. After the housing, when the hierarchy is established, such large pens permit more submissive animals to retreat from the agressives ones. Later on, such pens enable free moving and direct contacts with the boar in the pen nearby, which accelerates puberty and influences the synchronization of oestrus.

Gilts which after a certain period of time do not come in heat, are put together. In this way physical activity is intensified and stress is caused which incites the appearance of oestrus. When animals come in heat, they are transfered into individual pens of the insemination department where they are inseminated.

Sows from the farrowing department are also transferred into the individual pens of the insemination department after weaning. During the lactation the sow gets attached to her piglets and for this reason she is irritable towards other animals in the group. This irritableness is even more expressed because of the emotional stress caused by the weaning and the strain in the teats. All this intensifies the restlessness and aggressiveness of sows. This is why, after weaning, fights between sows are more intensive, with heavier body injuries.

Because of this, there are also more sows which come in heat late. Therefore, after weaning sows are not put together.

Oestrus is detected with the aid of boars; when it is established, its course and acceptance reflexes are controlled. All sows which after weaning do not come in heat within a certain period of time are put together in a collective pen with movable partitions, the same as is used for gilts. In this way heat is induced by stress caused by the transfer and by the uniting in a group. In the insemination department it is possible to influence the number of ovulated eggs by an appropriate nutrition and, after insemination, the rate of early embryonic mortality. For reducing embryonic mortality, it is important that sows are put together only after the implantation of egg cells.

2. Gestation department

In the gestation department it is important:

– that uniform groups are formed;

– that consequences of establishing the hierarchy are alleviated;

– that the nutrition is restricted and individual; and

– that pigs can move, although the surface is exploited to a maximum.

After the transfer from the insemination department, the animals are grouped by the date of insemination, their size and shape. The equalisation improves the coexistence in the group, and simplifies daily care and control over animals, while the large pen enables the establishment of the hierarchy.

In the gestation department it is important that nutrition is restricted, with individual feeding places by which it is possible to quickly get physically uniform animals. Sows in good breeding shape have better appetites, therefore they loose less weight and they are more lively during pregnancy, which probably reduces the frequency of leg injuries.

The gestation department was always poorly exploited, because of the too late discovery that certain sows were not successfully inseminated and because of the cull. This problem was solved with the pen with movable partitions which meant that the size of the pen was adapted to the number of animals. Besides the individual feeding places, such pens have enough space for animals to move and rest.

3. Farrowing department

The farrowing department enables:

– preparatives for farrowing;

– free moving and comfort of animals before farrowing;

– normal and quick farrowing;

– elimination of physical causes of losses of piglets;

– undisturbed access of piglets to teats;

– good hygiene; and

– simple access to piglets and to the sow.

When the sow is transferred into the farrowing department, she changes her environment as she moves from a collective pen into an individual pen. Although she has relatively more space, she feels restricted in the new pen. Therefore she must be free to the moment of farrowing. The possibility of movement reduces her restlessness before the farrowing, when she instinctively wishes to prepare the litter. Restlessness and discomfort can prolongate farrowing, which causes more piglets to be born dead (asphyxia) and less piglets to survive (hypoxia). For this reason the sow is blocked with the farrowing rail before the farrowing, when she calms down.

During farrowing and lactation, most losses of piglets are due to cold, hypoglycemia, lack of milk, genetic anomalies, infections and because the sow lies down on them. After farrowing the optimal temperature for piglets is much higher than the temperature in the piggery, therefore

they need additional heating, since their thermoregulating capacities are poor.

Piglets have to get colostrum as soon as possible. Where litter is not used, it is important to maintain a microclimate suitable for piglets and to have the floor perforated which helps to maintain good hygienic conditions in the pen.

In the farrowing department sows occupy the greatest part of the floor surface. The traditional arrangement of the pen does not allow any reduction of the surface, therefore we have designed a diagonal pen, by which up to 73% of the surface is saved. In such a pen the sow is easily blocked between the fixed diagonal rail and the movable partition. One access to the pen, for all operations during the farrowing and lactation, is simple and easy.

4. Rearing department

The arrangement of the rearing department must take into consideration:

– stress at the moment of transfer;

– adaptation to the new environment and establishing of the hierarchy;

– quick growth of piglets;

– hygiene and climate; and

– utilization of space.

The average weight of an early weaned piglet is very low. For this reason rearing at the time when passive immunity disappears while active immunity has not yet been developed is very demanding as far as housing, nutrition and health protection are concerned.

In the rearing department animals are separated by sex and by the objective of the rearing. Groups are formed without problems, since the individuality of piglets has not yet been developed and their fights are of short duration. In the rearing department, the most important factors for success, besides optimal nutrition, are good hygiene and an optimal climate. In two-tier cage batteries with a wire mesh floor, we have considerably improved hygienic conditions and by maintaining an optimal climate have improved health. Doubling of the capacity cheapens the construction.

The system of two-tier cage batteries gives a possibility of better exploitation of the piggery space in prefattening and fattening and a possibility to reduce the size of the building by one half. In this way it has become possible to design a combined pig house, with complete production under one roof.

We also tried to find a solution for two-tier box batteries, similar to those in the floor system of rearing, with the system of manure removal from the upper tier and the system of transfers from one box to another, from one department to another. In this way the two-tier systems would unite the complete production process, from the rearing to the final fattening. In the two-tier box batteries with wire mesh or slatted floor, hygienic conditions are much better. Because of greater density of animals, the quantity of animal heat is greater too, while ventilation and air conditioning have been improved too.

5. Fattening department for pre-fattening and fattening (Table 6)

During the pre-fattening and fattening, the following must be taken into consideration:

– growth rate, feed utilization and slaughtering quality;

– method of nutrition;

– density of population and good utilization of space;

– appropriate climate and hygiene.

Growth rate, feed utilization and slaughtering quality are the factors which are the most decisive for the economics of fattening. High growth rate shortens the time of fattening, while good utilization of feed influences the slaughtering quality.

Daily gains and slaughtering quality depend on nutritional methods. We practice feeding by

rations or feeding *ad libitum*. In the case of feeding by rations, the problem of moistening feed in troughs is solved by the installation of additional nipple drinkers above the troughs. In this way, during the feeding all animals are free to eat and drink according to their individual needs. In the case of feeding *ad libitum*, there is enough space at the troughs for two thirds of the animals. Above the trough there is a nipple drinker so that animals eat and drink by turns.

As we have already mentioned, one of the biggest problems on large scale farms is the transfer of animals from one production phase to another. These transfers require much disagreeable physical work and cause economic losses. With uniform box batteries for rearing, pre-fattening and fattening and for transfers from one box to another, we have solved the problem of transfers in the farmyard and prevented stress which causes lower gains and greater losses.

III - General management

1. Organization of the pig house

With the rational division of the piggery surface (taking into consideration biological and especially ethological requirements of pigs) into diagonal pens in the farrowing department, individual pens in the insemination department, pens with movable partitions in the gestation department and two-tier cage batteries in the rearing and fattening department, we have succeeded in housing a great number of animals under one roof. In this way investment costs per animal are reduced considerably, since one produced fattener comes from 0.32 sq.m. of the piggery surface or 0.50 sq.m. of the total surface of the farm.

The concept, exploitation and capacity of the piggery depend on the design of pens and cage batteries and on their exploitation. That is why we tried to find a solution in which the complete production process from insemination to sale would take place, where animals would be transfered from pen to pen, from department to department, like on a conveyor. The combined piggery, conceived in this way, is like a small farm, with complete closed production representing the basic unit or module of a certain capacity. Such an approach enables a farm complex to be constructed like a system of "Lego toy cubes".

The new farm building is adapted to building standard whose basic module is 3 m. Therefore there are buildings 6 and 9 m. large for small scale or mini-farms whose capacity is 1,250 pigs in one piggery; buildings 12 m. large for larger cooperative farms with a capacity from 1,250 to 2,500 pigs: and buildings 18 and 24 m. large for large scale farms with production from 5,000 to 12,500 pigs in one building (**Table 7**).

Maximum capacity is achieved if the width and the length of the building are in an optimal relation. In case of a large but short building, the surface of all building elements is smaller as is the surface of unproductive area (passages). Such a piggery is cheaper to construct, since all sorts of prefabricated elements of mass industrial production can be used. This also simplifies the construction and shortens the construction time.

The dimensions of pens are subordinated to construction standards as well. All pens and stalls are equal in size and represent the coefficient of the basic construction module of 3 m. With a correct disposition of pens, the maximum part of the piggery surface is productive surface and the transfer routes in the production process are the shortest possible.

It is also necessary to arrange air-conditioning, feed distribution and manure removal which is different for each of the production phases. For each development phase – category of pigs – there is a different temperature thermo-neutral zone, when the metabolism of animals is not burdened with the production of additional body heat or with emitting excess body heat. With the increased density of animals in all departments we have increased the quantity of animal heat which is important for heating in late autumn or in early spring. Additional heating is necessary only in the farrowing and rearing departments but there, as well, energy is saved.

Along with the development of new technology, new farms serve for testing of all new

technological solutions which become available, for private and for large scale public farms. New farm technology with new concepts of piggeries and their equipment are incorporated into pig production at private breeders and those working working in cooperation with large scale farms.

2. Organization of the farm complex

With the organization of complete production under one roof, the surface of piggeries has been increased. Such piggeries reduce the surface of the farm complex and of all infrastructure facilities and installations. New technological concepts completely change the arrangement of the farm complex, as far as construction and internal and external communications are concerned. Improved transport facilities which enable transport of feed to the piggery from outside over the fence, and loading of fatteners at the end of the piggery through the fence directly on trucks, mean that all access roads for external transport are outside the fence. The elimination of external transport represents a great advantage for health protection on the farm.

3. Nutrition

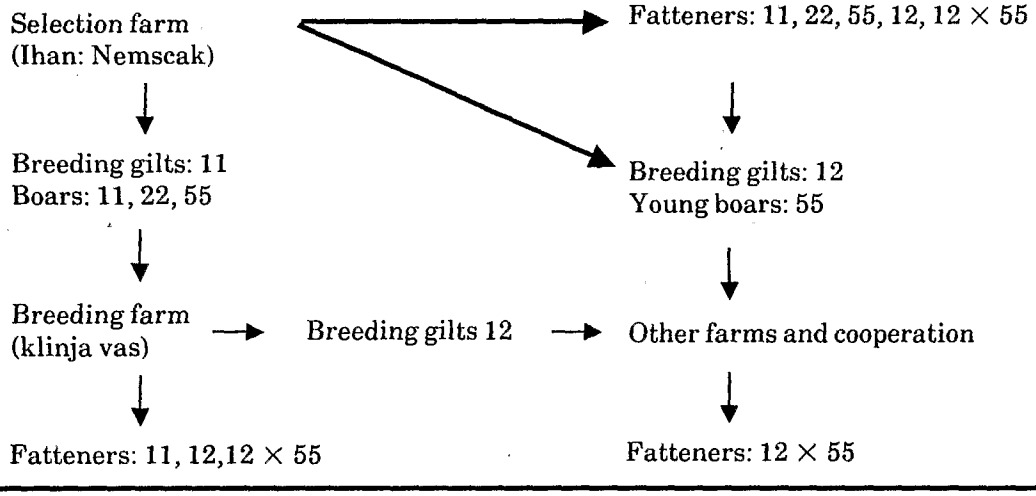
Maize is the main raw material for the nutrition of pigs and it is used in all feed mixtures which are supplied to the farm in bulk form. An important change in the nutrition of fatteners occurred when silage maize, which is more and more popular, started to be used. This also changed the relations between the farm and the feedmill.

Silage maize is stored in the vicinity of the farm, and all mixing is mostly done on the farm. The feedmill therefore manufactures only super-concentrates and feed for breeding sows and piglets. The selection of the silo for ensilaging is a question of economics. The greatest problem for large scale farms is the equipment, since a complete line from ensilaging in silos to distribution in the piggery does not exist. There is still much improvising, which causes great difficulties because of large daily quantities, especially when weather is bad. Ensilaged fodder is distributed in liquid form, which in our opinion is not an optimal solution, especially in those regions where maize with a lower level of humidity can be ensilaged. For this reason transport of the mixture of silage maize and a super-concentrate in dry form is being developed with the nutrition, described previously, which in our experience provides for a better utilization of feed and a better yield at slaughtering.

4. Selection

On large scale farms selection and reproduction are of great importance. It is possible to take advantage of large populations and of

Organization of the production of breeding pigs in Slovenia



continuous production in one place which enables one to select in a short period of time a great number of animals, with minimal influence from the environment. For this reason certain large scale farms are reorganized into selection farms which do their own testing of breeding material for renewal of their own basic herds and for needs of other farms and of private breeders. Over the last 20 years there has been large scale development of crossbred breeds such as Swedish Landrace, Large Yorkshire, German Landrace, Duroc, Hampshire and to a smaller degree Piétrain. Several combinations of crossing were selected. In Slovenia, from 1963 to 1973, 16 combinations of crossing were tested. From these, the best results were achieved by three-breed crossing 12 × 55 which was adopted as the basis of the breeding programme for the production of pigs in Slovenia.

Therefore, in 1973 a new organization of production of breeding pigs was introduced which is shown above.

According to the above, there are in Slovenia:

– selection farms (Ihan and Rakican) where the starting breeds A, B, C are selected and tested and where the production of breeding gilts A and AB and of youngs boars B and C takes place;

– breeding farms: selection and production of gilts AB; and

– other farms and cooperation: production of pigs for fattening ABC and fattening of three-breed crossbreeds ABC.

In 1984 the crossing was expanded with the new combination of mating 12 × 33 and 12 × 44, where the breeds Duroc and Piétrain were introduced. It is necessary to point out that in order to propagate quality breeding sows, a special fund has been established for financing the purchase of breeding gilts AB and of young boars C by all producers of fatteners.

IV - Environmental hazards

1. Health protection

The development of industrial pig production technology changes the entire pathology of animals, especially in certain production phases. Traditional diseases are replaced by new ones, imported with the breeding animals or caused by big populations and which have developed because of certain technological omissions. Health problems, especially in the rearing department, required new solutions, mostly for rearing of piglets. Health protection by use of antibiotics and chemotherapeutic substances was not sufficient, so that certain stomach and intestinal diseases spread to such an extent that the economics of industrial production was questioned. The new technological solution – rearing of piglets in cage batteries with wire mesh floor – radically changes this situation, and it can be attributed mostly to the improvement of the climatic and hygienic conditions in this production phase.

In the present development phase of large scale farm production, emphasis is put upon health protection. Wide-spread and sometimes uncontrolled use of medicines, especially antibiotics, leads one to question their efficiency. Therefore, in the case of numerous diseases, beside the usual health protection, the immuno-prophylaxis plays a more and more important part. Antibiotics and chemotherapeutic substances serve only as auxiliary means, first of all for preventing rearing diseases in suckling and weaned piglets. The use of medicines in feed is being increasingly replaced by their use in drinking water.

The economics of large farms which are hermetically closed from the external world prove how justified it has been to give up vaccination against traditional infectious diseases. In the greatest part of Europe swine pest does not represent a danger which would justify keeping the entire population in an active state of immunity. It is necessary to have a good control of the epizootic situation in the

vicinity and in the larger area and to vaccinate only in case of a direct danger.

2. Work organization

Successful pig production does not depend only on the productivity of the animal population, nutrition, health protection, reproduction, mechanisation and automation, but also on work organization on the farm. On large scale farms the basis of good organization is work sharing and specialization. For this reason, the production process is divided into production phases where the product of one phase is the beginning of the next phase (**Tables 8 and 9**).

In these production phases, health protection, selection, reproduction and maintenance services all play a role. Such organization enables employing good quality personnel whose objective is to achieve better economic effects with maximum work productivity and exploitation of production resources and minimum use of material and other resources.

Such organization, distribution and specialization of jobs in cooperative production can be very successful and rational if done by public farms which have their own production of breeding stock, their own feedmills and their own slaughterhouses.

In the case of publicly organized pig production on private farms, very strong professional services are involved, mostly including technologists and veterinarians. They assist breeders in selecting technological solutions, in deciding on the investment, in obtaining credit arrangements, in the construction of piggeries, in the selection of equipment, in the purchase of breeding animals, in the production itself and in health protection. The public farm organizes the production, supplies the breeding material, gives loans to breeders and buys their entire production at market prices and with regard to the quality established on the slaughtering line.

3. Environmental protection

On all pig farms we have to deal with liquid manure - slurry. The quantity of slurry on the farm depends on the concentration of animals in one place and on the economy of use of drinking water and of water for general cleaning. Because of the great concentration of animals, slurry is a major problem on farms. Since swine slurry has a great fertilizing value and its composition is good for plant nutrition, the only solution is to return these organic wastes to the land. But in order to reduce production costs it is necessary to condense the slurry by reducing the quantity of water to a minimum. The use of slurry is often interrupted because of vegetation, therefore it is necessary to have large tanks, which require a previous separation of solid and liquid parts, since swine slurry settles in a very inconvenient way.

When the liquid part is distributed on fields, it is necessary to consider optimal quantities in view of the agricultural crops and the possible pollution of underground water. Slurry is generally used in an economic way when the maximum capacity of the farm is 30,000 fatteners per year and when the farm is in the centre of an agricultural area.

Another method, which is the most expensive, is treating the liquid part in a treatment plant in combination with municipal waste waters.

Municipal waste waters are rich in mineral and poor in organic substances, whereas the waste waters of animal origin are just opposite. By mixing the two, the high concentration of waste waters of animal origin is diminished, which favourably influences anaerobic and aerobic treatment of both effluents. There is still much work for experts in the field of the slurry treatment, however, if they want to find the cheapest solution.

Nowadays this does not pose a problem when a certain technology is evaluated, if animal requirements, economic conditions and market demands are known. It is possible to achieve equally good production results with different technologies, but not the same economic effects which depend not only on good production results but also on economic-technical solutions. Technological-technical solutions influence the:

- costs of construction of production and infrastructure facilities;

– degree of mechanisation for reduction of the scope of human work;

– functional exploitation; and

– maintenance costs.

The complete technological concept described represents a real innovation in farm production whose economic effects are felt during construction and later on during production, where work organization is simplified and higher labour productivity is achieved. Of special significance is uniform equipment and construction for a small piggery of a private breeder or for the largest fattening or selection farm.

An example of the advantages that this new technology offers is the Ihan Emona Ljubljana farm in Yugoslavia, which was built in 1958-59 on the basis of Scandinavian technology. This farm was reorganized in 1966, when a slatted floor was introduced and in 1974 when cage batteries with wire mesh floor were installed. This farm is a traditional farm, with specialized piggeries and a capacity of 55,000 fatteners a year. In 1980 the capacity of the farm was increased to 85,000 fatteners, with the construction of a new farm whose capacity is 30,000 pigs in three buildings, each for an annual production of 10,000 pigs under one roof, using the technology described in this paper.

Table 1: Pig production on public farms and in cooperation with private breeders, as % of total production

Year	Farm production	Cooperation	Total	Unorganized production
1959	6.3	4.1	10.4	89.6
1960	9.5	13.0	22.5	77.5
1965	15.4	12.5	27.9	72.1
1975	18.7	13.2	23.9	68.1
1984	25.0	17.9	42.9	57.2

Table 2: Meat consumption per inhabitant

Year	Yugoslavia		Austria	
	Pig meat	Total meat	Pig meat	Total meat
1960	12.9	31.2	33.3	59.3
1965	14.3	30.9	35.3	62.9
1970	14.3	38.1	44.4	68.8
1975	17.8	51.3	38.2	78.3
1980	21.0	57.6	45.0	87.4
1983	20.0	56.5	47.7	86.9

Table 3: Arable land of rural estates in Yugoslavia

Sector	Year	Estates number	%	Arable land 1,000 ha	%	Hectares per estate
Private	1955	2,563,619	99,70	9,023	89.3	3.52
	1984	2,672,539	99,87	8,171	82.9	3.05
Social	1955	8,366	0,30	1,077	10.7	128
	1984	3,461	0,14	1,687	17.1	478

Table 4: Arable land per state in Western Europe and in Yugoslavia

Country	Total arable land 1,000 ha	No. of states 1,000	Ha per estate
England	16,934	244	69.4
France	29,231	1,079	27.1
Denmark	2,887	110	26.1
Ireland	5,068	225	19.9
Holland	1,998	124	16.1
West Germany	12,046	764	15.8
Italy	16,271	2,192	7.2
Greece	3,125	732	4.7
Yugoslavia	9,858	2,676	3.7

Table 5: Production of pigs and of pig meat in Yugoslavia

Sector	1960	1970	1980	1984
No. of pigs (000)	6,208	5,544	7,501	9,337
Social sector %	10.1	18.8	20.4	23.6
Private sector	89.9	81.4	79.6	76.4
No. of breeding sows (000)	937	958	1,238	1,523
Social sector	10.0	9.5	8.0	10.9
Private sector	90.0	90.5	92.0	98.1
Total no. of slaught. pigs (000)	7,012	8,786	13,090	14,418
No. of pigs slaught. in slaughterhouses (000)	1,827	3,710	5,301	5,749
% of all slaught. pigs	26.0	42.2	49.5	39.9
From social sector %	8.1	19.7	21.4	25.0
From private sector %	18.0	22.5	19.1	14.8
Production of pig meat (000 tons)	291	339	461	569

Table 6: Exploitation in the piggery, expressed in number of fatteners per sq.m., in different organizations of the farm complex

	Surface of piggery	Annual production of fatteners	Fatteners/ 1 sq.m.	Index (Scand. tech. = 100)
Scandinavian traditional organization 1958	29,900	18,000	0.60	100
Specialized piggeries for individual prod. phases with slatted floor (1966)	27,180	40,000	1.47	245
Specialized piggeries with partially united prod. phases and rearing in two-tier batteries (1974)	27,180	55,000	2.04	340
Combined piggery with closed production one roof (1980) ...	10,800	30,000	2.78	463

Table 7: Comparison of farm size with infrastructure facilities on a traditional farm (specialized piggeries) with a new farm with new technology (combined piggery for closed production under one roof)

		Farm with specialized piggeries (1)	Farm with combined piggery (2)	Index 2 : 1
Surface farm	m^2	53,312	17,630	0.33
Surface of roads	m^2	11,749	1,836	0.16
External water supply	m	335	80	0.24
External electr. network	m	546	80	0.15
Sewage	m	516	257	0.50

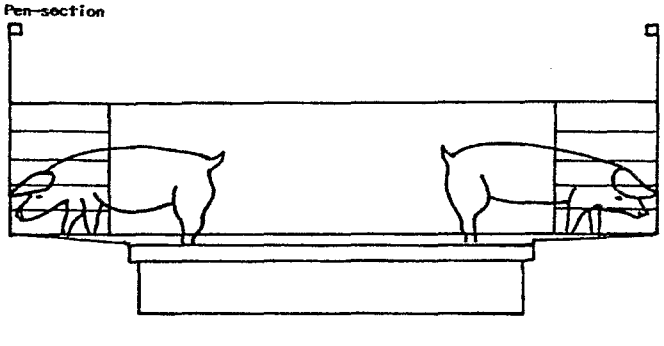
Table 8: Productivity of work: Number of fatteners per worker in four different types of organization of farm complex

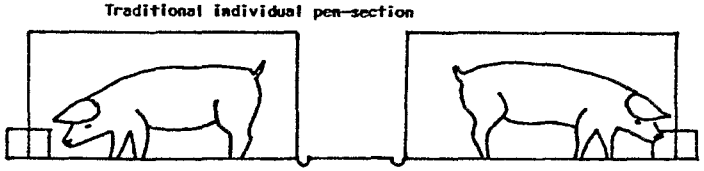
	Annual production of fatteners live weight in kg	No. of workers	No. of fatteners	Index (1958 = 100)
Scandinavian traditional organ.	18,000	36	500	100
Specialized piggeries for individual prod. phases with slatted floor (1966)	40,000	23	1,739	347
Specialized piggeries with partially united prod. phases and two- tier cage battery rearing (1974)	55,000	23	2,391	478
Combined piggery with closed production under one roof (1980)	30,000	6	5,000	1,000

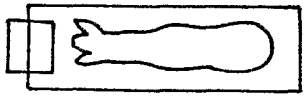
Table 9: Working hours of direct workers on the farm for production of pigs of 100 kg of live weight

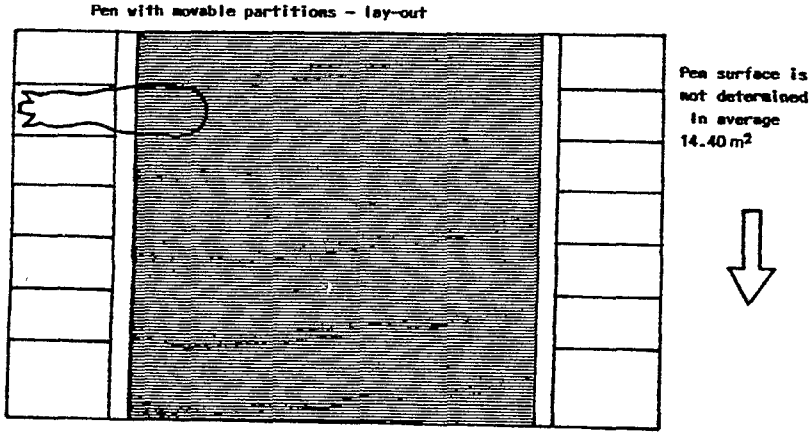
	Annual production of fatteners live weight in kg	No. of direct workers	No. of working hours	No. of working hrs for 100 kg gain
Scandinavian traditional organ.	18,000	36	78,624	4.36
Specialized piggeries for individual prod. phases with slatted floor (1966)	40,000	23	50,232	1.26
Specialized piggeries with partially united prod. phases and two tier cage battery rearing (1974)	55,000	23	50,232	1.00
Combined piggery with closed production under one roof (1980)	30,000	6	13,104	0.44

Pen with movable partitions for inseminated sows

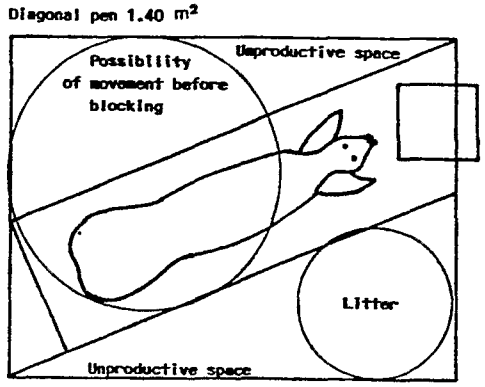


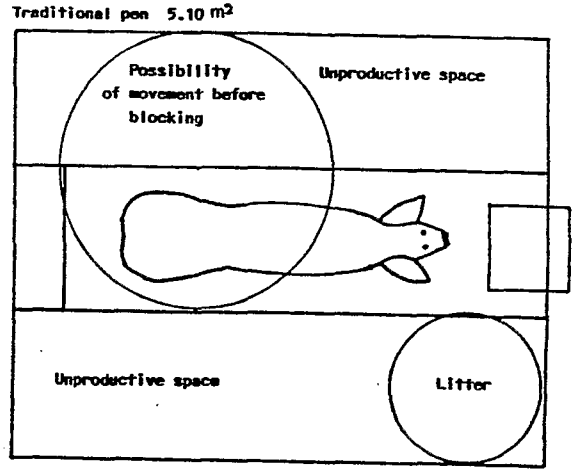






Farrowing pen





Saving in case of diagonal farrowing pen: 40% of the piggery floor surface