FEASIBILITY OF ADOPTING AQUACULTURE WITHOUT DETRIMENT TO EXISTING FARMING PRACTICES: A CASE OF BANGLADESH FARMING SYSTEMS

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Feasibility of Adopting Aquaculture Without Detriment to Existing Farming Practices: A Case of Bangladesh Farming Systems

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Abstract

Integrated agriculture-aquaculture that would draw inputs from on-farm sources is viewed as a viable option to improve the productivity, income and resource use efficiency of existing farms in Bangladesh. To assess the existing resource availability, use pattern and efficiency before introducing new aquaculture technology within the existing farm systems, a survey of 330 pond operating farm households was conducted in six selected unions from two thanas (subdistricts) of Bangladesh. Results showed that very little labor was used by existing aquaculture practices. However, labor productivity may increase once an improved aquaculture practice is adopted. Similarly, on-farm by-products and waste materials such as rice bran, cowdung and kitchen wastes are extensively used in crop fields and for livestock feeding. However, farms can augment the availability of these resources for aquaculture through better farm management and through minimizing low productive uses.

Introduction

In Bangladesh it is quite common for a farm to produce a wide range of food crops, cash crops, horticulture products, animals and fish, and to use many outputs and by-products of one subsystem as inputs to other subsystems of the farm (Fig. 1). The operation of these enterprises is largely based on existing farmer knowledge; adoption of improved methods and techniques that would imply a more intensive use of inputs has taken place only slowly. In the case of fish farming, it is only recently that the adoption of improved technologies has been seen as a viable farm operation. On the other hand, farmers are gradually becoming starved of land and capital while labor, as well as farm-generated bioresources and by-products, are extensively available on the farms. An integrated agriculture-aquaculture strategy that would draw inputs from on-farm sources is viewed as a viable option for improving the productivity, income and resource use efficiency of existing farms.

A recent survey of small waterbodies in sample village units in Kapasia and Sreepur thanas (subdistricts) in the district of Gazipur revealed that at present, only 1% of the waterbodies were following improved aquaculture methods (regular stocking, feeding, fertilizing and harvesting). Polyculture of major Indian carps (*Labeo rohita, Catla catla, Cirrhinus mrigala*) is a common practice in most of the farmed waterbodies. Harvests from farmed and non-farmed waterbodies, however, consisted of both stocked and wild fish. The average fish yield was only 546 kg/ha/year (Ahmed 1992). However, improved aquaculture technologies that combine culture of

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major Indian carps with common and Chinese carps; and the culture of short-cycled species such as tilapia (*Oreochromis niloticus*) and silver barbs (*Puntius gonionotus*), have the potential to increase productivity by as much as three times (Gupta et al. 1992).

A project is currently under way to assist farmers in the adoption of improved fish culture through the provision of extension services and training in one of the two thanas mentioned above, as well as to assess the impact of improved fish culture practices within the farm economy (Fig. 2).

Objectives

Main:

- To examine the resource allocation implications for an integrated agriculture-aquaculture under the existing farming systems of Bangladesh.

Specific:

- To identify farm resources that are considered potential inputs to low-cost, low-input aquaculture technology.
- To determine the existing allocation pattern of farm resources over different enterprises.
- To explore the possibilities of integrating aquaculture within the farm without detriment to existing farm practices.

Methodology

A survey on resource availability and resource use by farm households over different enterprises was conducted in six unions of the two thanas taken for the project studying the impact of fish culture extension. Sample households were selected from amongst the owners and operators of existing small waterbodies (ponds/ditches) in the six unions. Households were stratified by size of waterbodies - small (below .06 ha), medium (.06 to .12 ha) and large (above .12 ha) - and a total of 333 pond-operating households were randomly selected taking proportionate samples from each stratum. Data on the availability of resources, their use pattern and farm production were obtained for a one-year-period covering 1990-91, using a predesigned questionnaire. Statistical analysis was done in terms of simple frequencies, means and percentages.

Results

Land Availability and Utilization

Fig. 3 gives a picture with regard to the availability of land and its allocation among different farm enterprises of pond operating households. It shows that on average the

households own 2.31 ha of land, of which pond and ditches occupy only .08 ha (3.5%). Again, on average, households cultivated 1.02 ha of land for production of various crops from a total of 1.56 ha actually cultivated by farmers during 1990-91. Thus, crops occupied most of the lands operated by the farmers.

Labor Availability and Utilization

Fig. 4 presents the labor utilization pattern of the households over different enterprises. It shows that very little labor time (2%) was used in aquaculture, whereas as high as 68% of labor time was devoted to the cultivation of crops. Table 1 shows average labor-output ratios in current aquaculture practices, which is 1.3 times higher for users of material (feed and fertilizers) inputs than for non-users.

On-farm By-products and Water Resources

Farmers usually generate by-products and waste resources which are in turn used as inputs into subsystems of the farm. Rice bran, cowdung, compost, poultry droppings and kitchen wastes are generated by most farmers. On the average, farm households generate one t of rice-bran, 6 t of cowdung and 880 kg of kitchen wastes (Fig. 5). These are also important ingredients for small-scale aquaculture. Fig. 6 shows current uses of these resources over different enterprises. Almost 58% of total rice bran production and 89% of kitchen wastes were used as animal feed. More than 80% of the total available cowdung was used in crop fields. Aquaculture, in general, made very little use of all the above resources.

Discussion

Land, as the most scarce resource in Bangladesh, poses a serious limitation to horizontal expansion of farm enterprises. Vertical expansion of land use by way of increasing soil fertility, transferring lands from lower productive enterprises to higher productive enterprises and utilization of unused/fallow lands, are some of the remaining options to increase farm production. Although the current allocation of farm land to waterbodies (ponds/ditches) is very small, returns from such land can become high if improved aquaculture is adopted on the farms. Land allocation in aquaculture might even expand in the future by including fallow lands and unused lands as a result of adoption of improved aquaculture technologies that are currently being disseminated (Ahmed 1992).

Aquaculture was found to take very little labor time of the households compared to the crop and livestock sectors. It is expected that demand for labor will increase significantly with the introduction of improved aquaculture. Again, the higher output-labor ratio shown in Table 1 implies that the introduction of improved aquaculture will enable labor to obtain a higher marginal productivity.

The additional labor under improved aquaculture will still be small as compared to the size of labor demand in the entire farm. Farm households will, therefore, be able to allocate labor time from its surplus/unused labor force without hampering the activities of other enterprises. Most household labor time is currently absorbed by the crop sector where demand for labor is

seasonal. Demand for labor reaches a peak during planting and harvesting times. Aquaculture as such has no peak or lean season. Fish can be stocked and harvested any time. Hence, the farmers can adjust their time with regard to fingerling stocking and harvesting to suit their conditions.

Like labor, crops absorb most of the on-farm by-products and waste materials. On the other hand, crops are also the main source of on-farm resources like rice bran, household wastes and some of the ingredients of compost preparation. However, a sizable proportion of rice bran and cowdung which can potentially be used for aquaculture was found to be used either to generate bio-energy and maintain houses or to be sold as surplus. The cost effectiveness of these resources in generating bio-energy and in maintaining houses should be a subject of future investigation. Yet there remains the possibility of redirecting these resources into aquaculture, if alternative sources of fuel and house materials can be found as substitute for existing uses.

Production of rice bran is directly linked with the crop yield and rice processing technology. It can be augmented through the use of modern husking techniques (milling), which is already popular in rural areas. Farm households usually sell surplus paddy without processing. If the opportunity cost of rice bran increases, households will be induced to sell processed rice in the markets and thereby increase the on-farm supply/production of rice bran.

Production of compost can be increased manifold through the dissemination of knowledge relevant to its preparation. Important ingredients of compost preparation such as straw, cattle dung and waste materials are available within the farm (Fig. 7).

Farm households make little use of composts and poultry droppings. Under the current free range strategy of poultry/duck rearing there are no feasible techniques for collection or cycling of droppings. This, however, can be increased by improving the rearing practices of poultry birds in closed environments such as fish-poultry culture.

Conclusion

Studies are under way to examine how resources are being reallocated as a consequence of adoption of improved aquaculture practices. It is expected that a large quantity of resources previously under use in non-aquaculture enterprises will now be shifted to aquaculture. The preliminary analysis presented here suggests that these shifts in resource use will probably increase the overall productivity of farming systems in Bangladesh.

References

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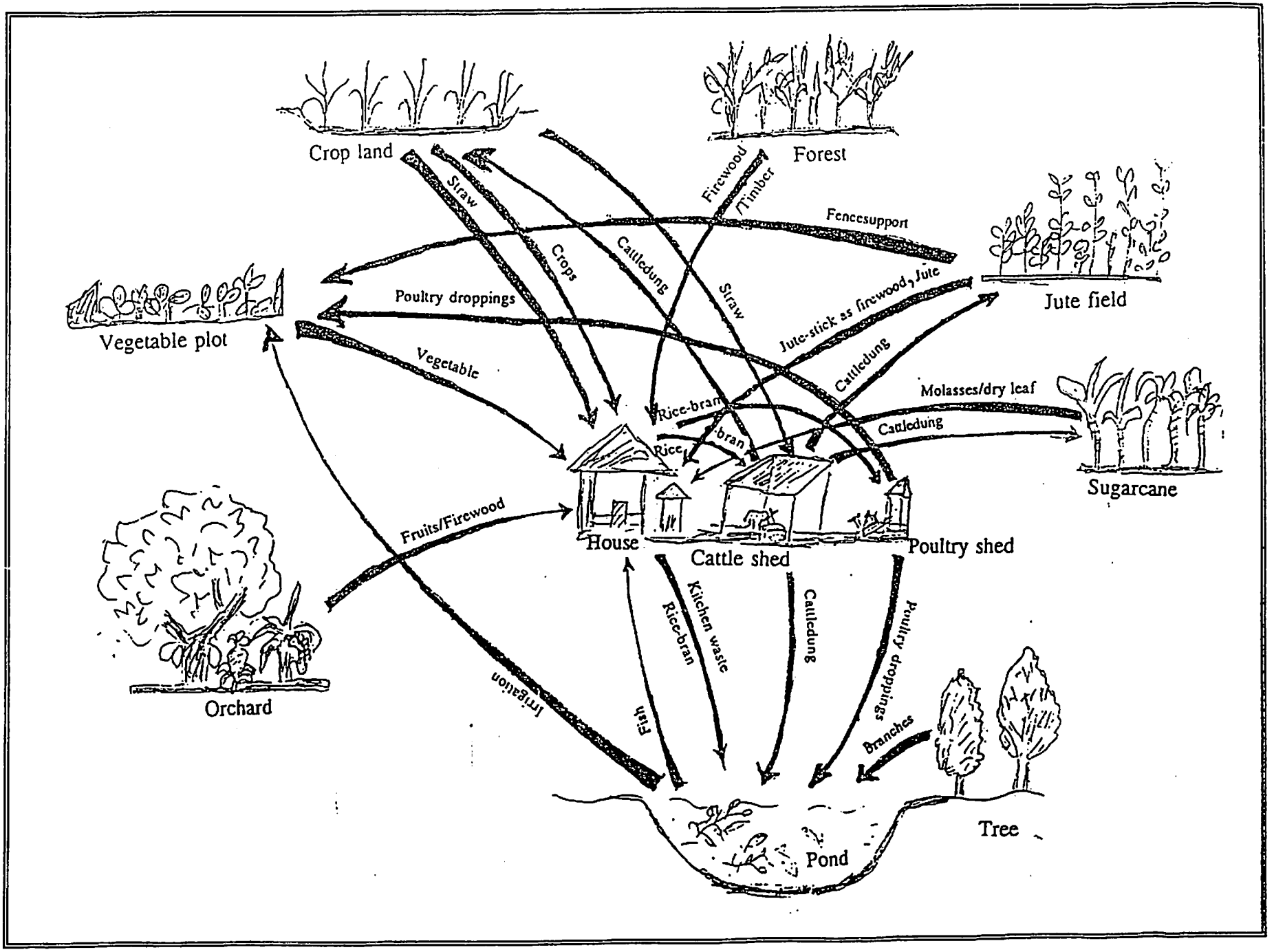
Gupta, M.V., M. Ahmed, M.P. Bimbao and C. Lightfoot. 1992. Socioeconomic impact and farmers' assessment of Nile tilapia (*Oreochromis niloticus*) culture in Bangladesh, ICLARM Tech. Rep. 28, 130 p.

Table 1. Output-labor ratio of users and non-users of material inputs (feed, fertilizer, etc.) for existing aquaculture practices in the thanas studied.

Type of farm	Labor use (mandays/farm)	Output (fish) (kg/farm)	Output-labor ratio (kg/manday)
User of materials inputs [n=178]	6.59 (14.25)	82.15 (128.44)	12.47
Non-user of material inputs [n=155]	3.77 (14.32)	35.76 (164.55)	9.49
All [n=333]	5.28 (14.28)	60.56 (147.95)	11.46 11.46

Fig. 1. Hypothetical Resource Flow Diagram of the Faming Systems in Bangladesh



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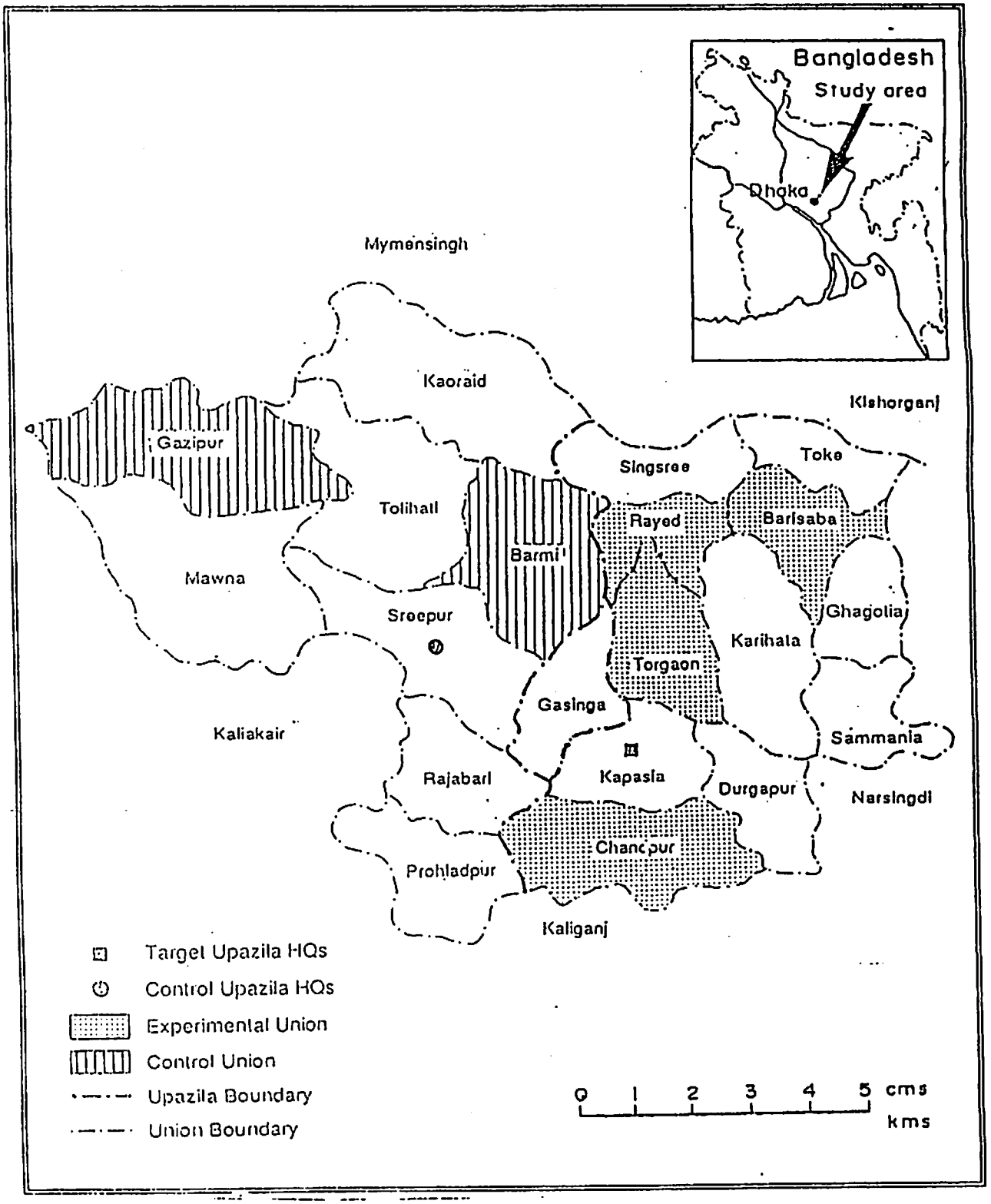

Fig. 2. Map of the two thanas under the project "Impact of Fish Culture Extension on the Farming Systems of Bangladesh".

Fig. 3. Land Owned and Operated by the Farm Households

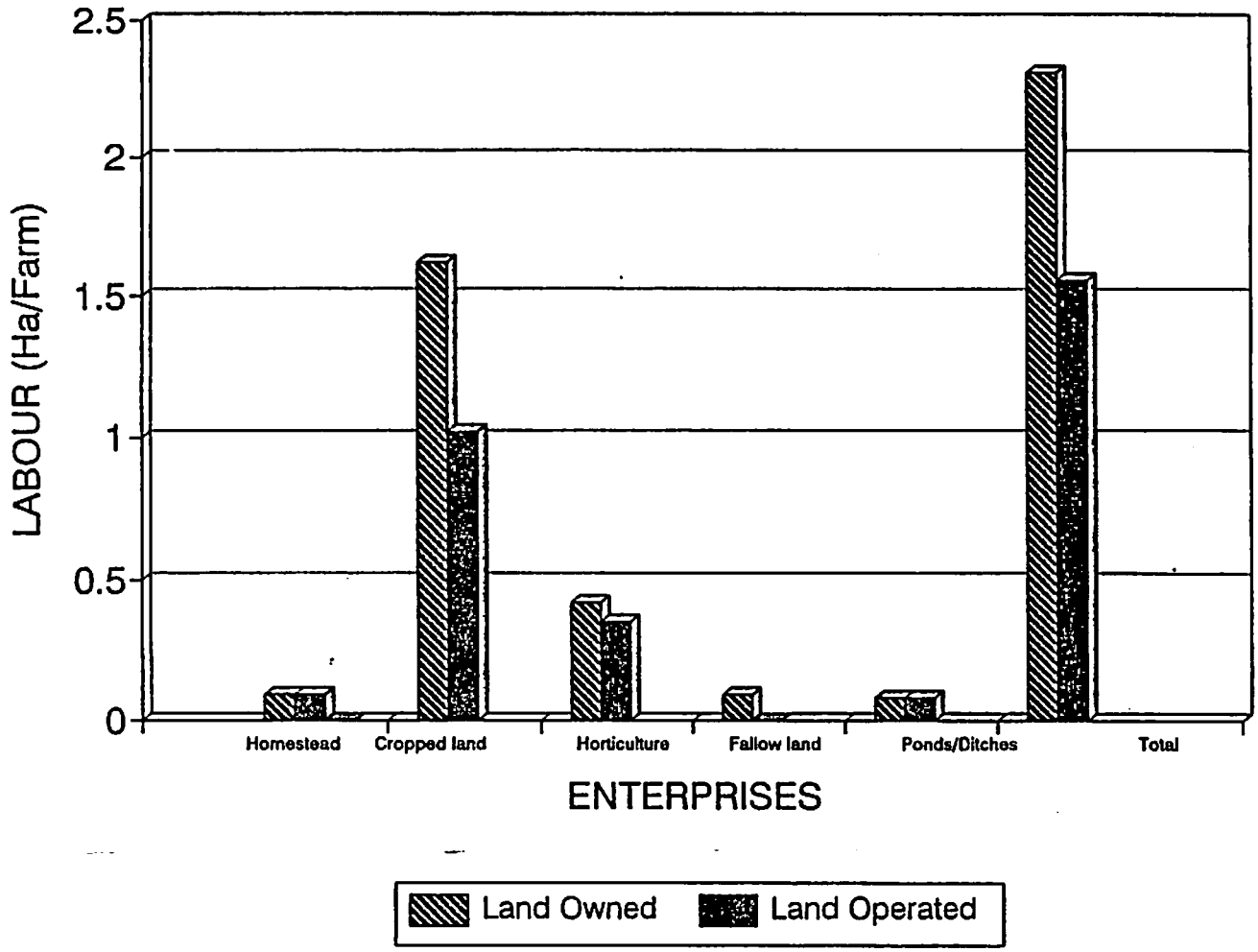

Fig. 4. Distribution of Labour in Different Farm Enterprises

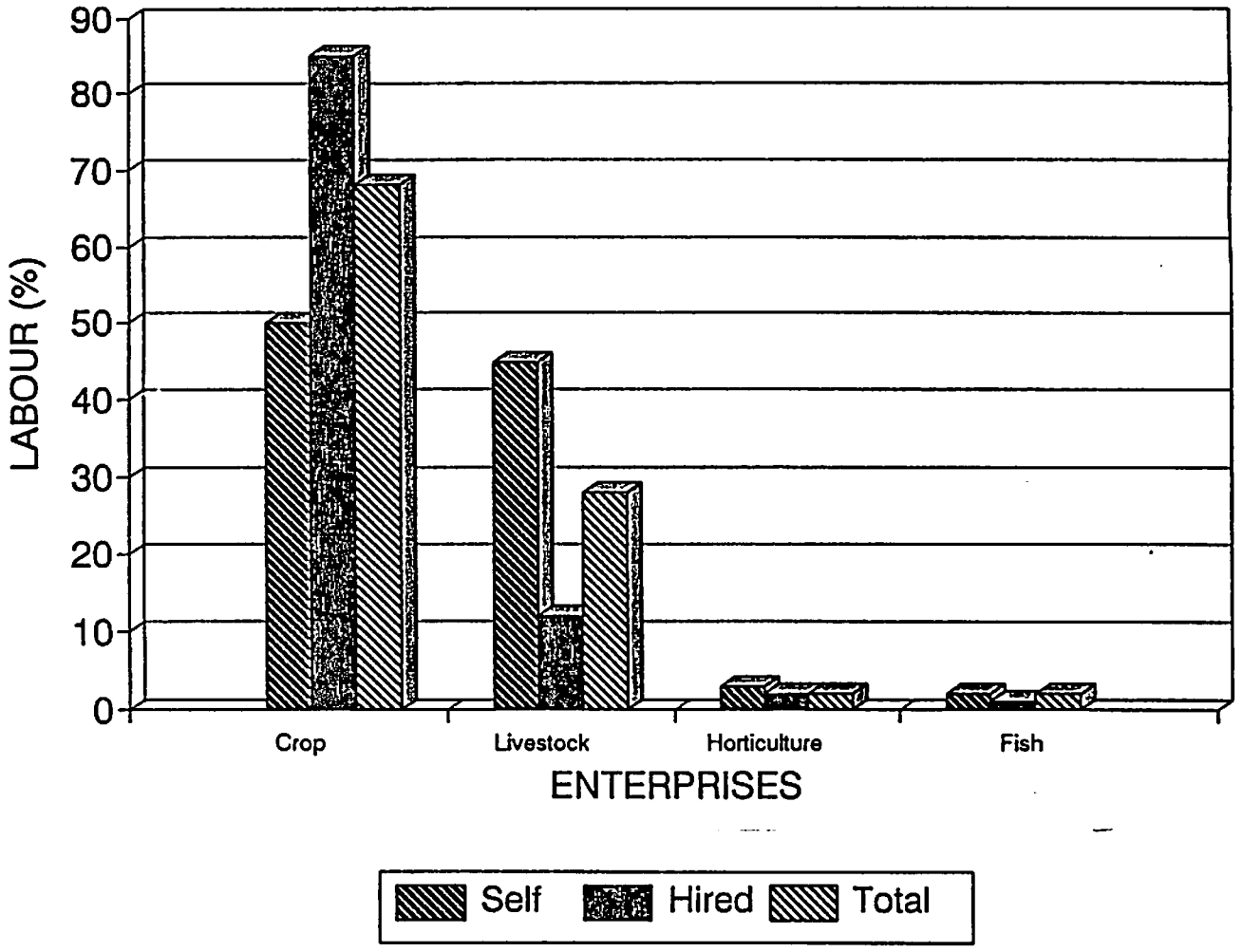

Fig. 5. Total Availability of By-products and Wastes in the Farm

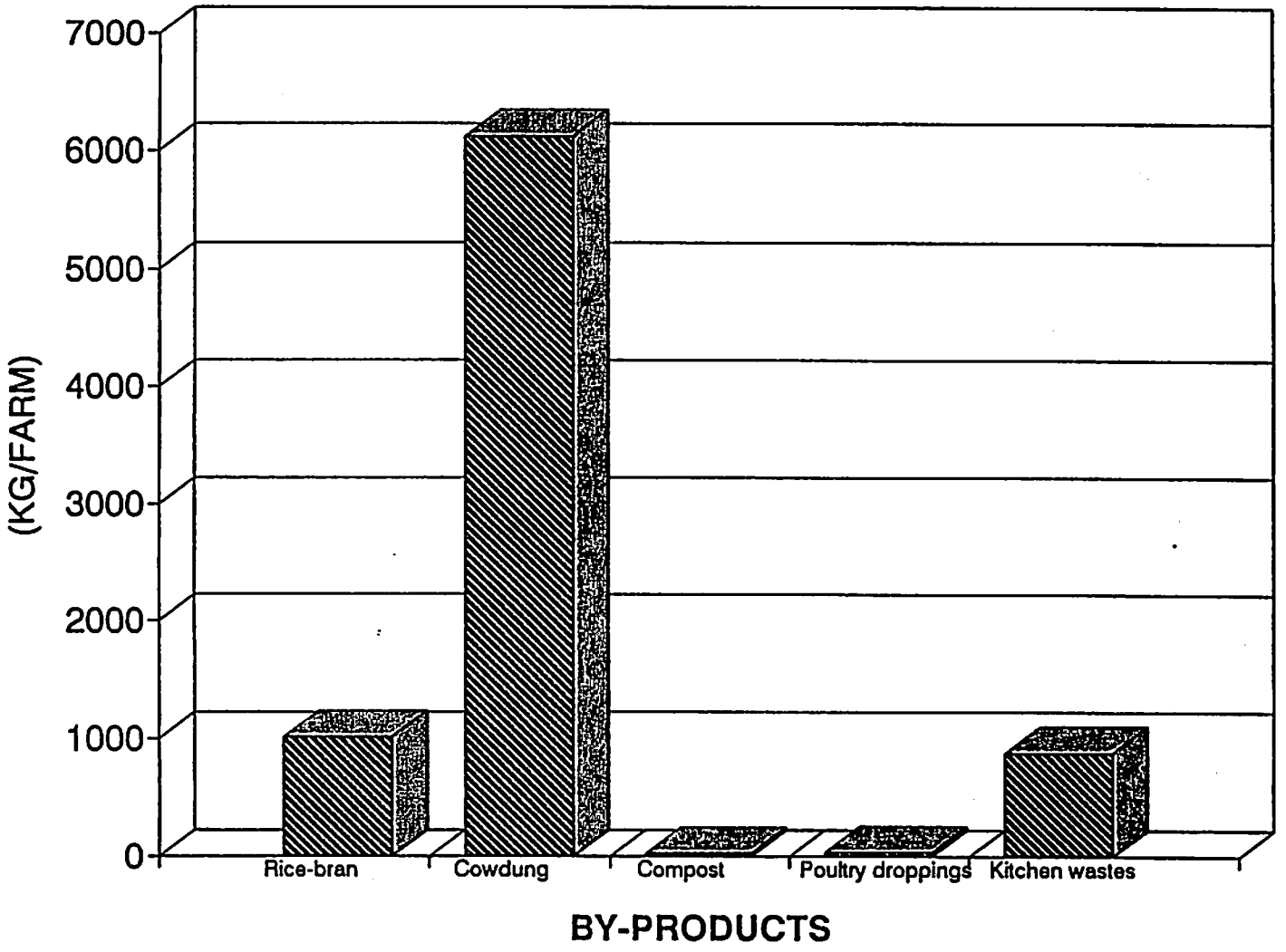

Fig. 7. Fish Pond Receiving Fertilizer and Feed Materials from On-farm Sources

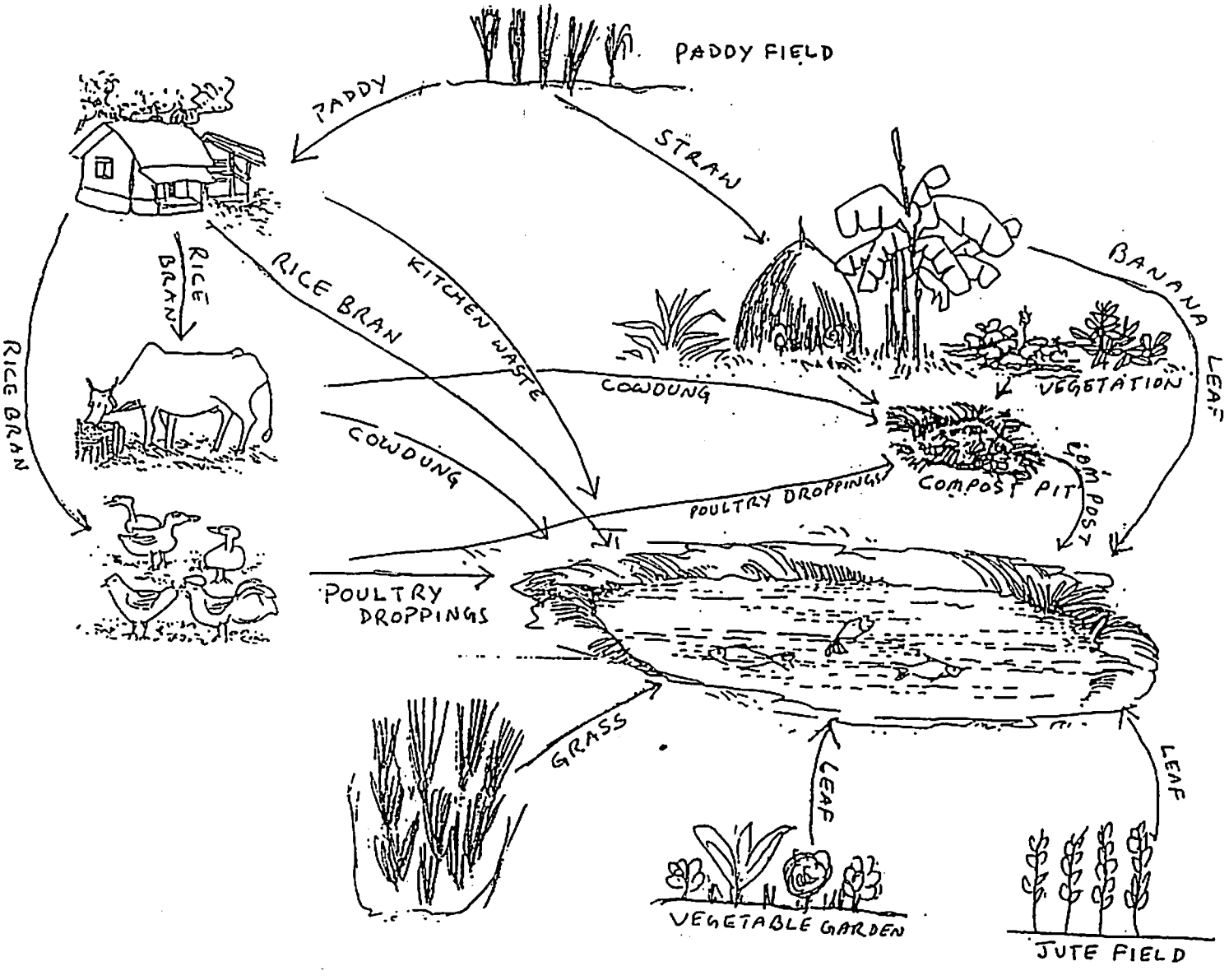

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Fig. 6. Use Pattern of By-products and Wastes (in %)