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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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REGIONAL CO-OPERATION AMONGST DEVELOPING COUNTRIES IN THE FERTILIZER INDUSTRY

Opportunities in Least-Developed Countries to Establish Facilities for the Production and Distribution of Fertilizers and the International Co-operation Required *

Background Paper

by the UNIDO Secretariat

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INTRODUCTION

1. This paper summarises the results of a survey of investment opportunities for the establishment of facilities for bulk-blending/bagging fertilizers or manufacturing fertilizer in 23 of the least-developed countries (LDCs) in Africa, the Middle East and Asia. The survey was made by UNIDO in co-operation with FAO.1/ The full survey will be made available as a UNIDO internal document (UNIDO/IOD/).

2. The survey was prepared in response to a recommendation of the Expert Group Meeting on Regional Co-operation among Developing Countries in the Fertilizer Industry held in Vienna from 8 - 10 February 1978 (a) that special attention should be given to ways of ensuring adequate supplies of fertilizers for least-developed countries and other developing countries with a small population, and (b) that UNIDO should identify projects and propose specific measures to aid these countries which could be considered by the Second Consultation Meeting on the Fertilizer Industry.

3. For each country covered, the survey gives a brief account of (a) the fertilizer market and trends in fertilizer use; (b) problems encountered with the transport of fertilizers from the port to their final destination; (c) the availability of energy resources and raw materials suitable for local fertilizer manufacture; and (d) the investment required to establish a local plant to manufacture, bulk blend or bag fertilizers.

4. During the period May to September 1978, UNIDO consultants visited Guinea, Somalia, People's Democratic Republic of Yemen, Yemen Arab Republic, Burundi, Malawi, Rwanda, Sunda, the Central African Empire and Nepal. 2/

1/ The survey was financed by UNDP under the Regular Programme.

2/ The consultants were F.J.E.van Dierendonck, K.R.Krishnaswami and M.C.Verghese.

5. In addition, information needed for the survey was collected from reports of previous missions conducted by UNIDO in Ethiopia (1975), Mali (1975), Upper Volta (1972), the Sudano-Sahelian Zone (1976/1977), Benin (1977), Bangladesh and Afghanistan (1975); and by FAO in Ethiopia (1975), Tanzania (1976 and 1977), Afghanistan (1978) and Nepal (1978).3/

CONCLUSIONS AND RECOMMENDATIONS

African Countries

6. Fertilizer is used on only 6 percent of the cultivated land in the 18 African countries surveyed, mainly on estates and small holdings that produce cash crops for export or grow cereals for the local market. The present average consumption of 13 kg of fertilizer material per hectare of cultivated land illustrates the potential for market expansion.

7. The survey forecasts that consumption of fertilizers in the 18 African countries surveyed will exceed 800,000 tons by 1980 compared to 500,000 tons in 1976. Consumption of compound fertilizers should exceed 300,000 tons in 1980 compared to 150,000 tons in 1976. (For details see Table 1).

8. The major constraint curbing growth in the use of fertilizers is the high cost of transport, the resulting high cost of fertilizers to the farmer, and also the inability of Governments to finance imports and/or provide the subsidies needed to make the use of fertilizers remunerative to farmers. In land-locked countries the price of fertilizers to the African farmer is two to three times the ex-factory price in Europe as shown in Table 2. In many countries, congestion in their ports, an inadequate railway system and a lack of paved roads add to the transport costs and leave little immediate scope for substantial savings in the cost of bringing imported fertilizers to the farmers.

3/ For references to the country reports, see the full text of the survey (UNIDO/IOD).

9. All of the 18 African countries are dependent at present on supplies from abroad, except Tanzania. The only definite new project for fertilizer production is in the Sudan. The survey identifies new opportunities for investment in half of the 18 countries surveyed.

10. At present, fertilizers are imported in bags. For African countries that have port facilities to receive large shipments and a market to absorb annually at least 8,000 to 10,000 tons of straight or compound fertilizer such as Benin, Ethiopia, Somalia and Guinea, there may be an opportunity to invest in port handling equipment for the receipt of bulk cargoes, in bulk blending, storage and bagging facilities. The survey suggests that viable projects can be established in these countries. Guinea is considering to establish a double stream blending plant of 2 x 50,000 tons annual capacity which later may be integrated into a fertilizer manufacturing complex. The viability of the project is yet to be assessed.

11. For land-locked countries, local manufacture of fertilizers on a small scale is recommended. Chad, Rwanda and Malawi have the energy and/or raw material resources to produce nitrogenous fertilizer; Malawi, Burundi, the Central African Empire, Mali and Upper Volta each have all or some of the raw materials needed to produce phosphatic fertilizer. Although the cost of production in small scale units will be high, it will in most cases, compare favourably with the very high cost of imported fertilizer. More important, local manufacture could provide a reliable source of supply and all the benefits of self-reliance.

12. Afghanistan and Bangladesh produce nitrogenous fertilizers (urea), from natural gas and are in the process of establishing new capacities to supply growing domestic demand. Bangladesh produces phosphate fertilizers (TSP) to cover part of the domestic demand, from imported phosphate rock and sulphur. Afghanistan has plans to establish such facilities based on sulphur (recovered from natural gas) and phosphate rock from local deposits.

13. The fertilizer market in Yemen Arab Republic and the Democratic Republic of Yemen is too small at present to justify the establishment of either nitrogenous or phosphate fertilizer production facilities. Furthermore, these countries have no known deposits of raw materials.

14. A similar bulk-blending/bagging plant is being considered by Nepal, where the viability of a small-scale plant to manufacture ammonia and ammonium nitrate based on electrolytic hydrogen is also being studied.

Granulation

15. Bulk-blending followed by compounding and granulation is not feasible for the small scale operations considered in this report. The very small market demand for a particular product mix would render compounding economically not viable. Granulation plants are more sophisticated than bulk-blending units and are recommended only when the market demand for a limited number of NPK compounds exceeds 100,000 tons per year.

Recommendations

16. The survey recommends:

(a) that detailed feasibility studies be made of the opportunities identified for the local manufacture of fertilizers based on local raw materials. Before a national project is implemented the opportunity for that plant to serve the regional market should be examined.

(b) that due consideration should be given to all aspects which have bearing on the delivered cost of fertilizer to the farmer. Local bulk-blending may offer a cost advantage of 10 to 20 percent, in comparison with the cost of imported multi-nutrient fertilizer in bags or in bulk. However, the advantage may

appear slight when technical difficulties in bulk handling and transportation under adverse climatic conditions are taken into account.

(c) that steps be taken to ensure that the viable projects are implemented,

(d) that engineering firms re-examine the designs and blueprints of small scale plants to adapt them to the specific requirements of the least-developed countries. Furthermore, efforts will have to be made to solve technical problems encountered in bulk handling of fertilizer materials in the hot and humid climatic zones.

(e) that the Governments of the least-developed countries continue or introduce subsidies and adopt other measures to promote a further sustained increase in the use of fertilizers.

17. The Consultation Meeting may wish to endorse these recommendations and consider whether the Governments of developed countries, international agencies and/or international financial institutions can finance:

(i) the feasibility studies recommended in the survey

(ii) the establishment of projects found to be viable by least-developed country concerned

(iii) supplies of fertilizer on concessional terms, pending completion of such plants

(iv) the cost of inland transportation in the case of land-locked countries.

SUMMARY OF THE SURVEY

I. The present situation in 23 least-developed countries

A. Trends in Fertilizer Use

18. The use of fertilizers in the 18 least-developed countries of Africa covered by the survey has increased steadily over the past ten years. In 1976, their consumption of fertilizers totalled about 500,000 tons and by 1980 it may exceed 800,000 tons (see Table 1).

19. Average consumption of fertilizer material used per hectare of cultivated land is only 13 kg - well below the level achieved in most other developing countries. Consumption of fertilizers per hectare ranges at present from less than 1 kg in Guinea to 35 kg in Malawi and the Sudan. The intensity of fertilizer use in different countries depends on the extent to which farming is commercialized and producing for export. Fertilizers are used on export crops like coffee, tea, cotton, tobacco, groundnuts and sugar cane, and accounted for 70 percent of fertilizer consumption in 1976. The balance was used for commercialized farming of rice, maize and wheat production.

20. The use of multi-nutrient fertilizers has increased in the period 1970 to 1976 and it now accounts for 50 percent of fertilizer consumption in most of the African countries surveyed. One country covered by the survey, the Sudan, is a large consumer of straight fertilizer. Compound fertilizers are mainly used for commercialized crops like cotton, coffee, tea and tobacco (and sometimes rice), brought under intensive cultivation by either estate farms or state organizations entrusted with agricultural development programmes. Compound fertilizers have become popular because they facilitate distribution and handling operations, fertilizer extension and promotion work, shaping and implementing price policies, and application by farmers.

B. Sources of supply of fertilizers

21. The 18 African countries surveyed imported 80 percent of their fertilizer supplies in 1976. Most of the imports came from Europe and the Middle East, but some came from Japan and North America. All fertilizers were supplied in bags except for small quantities to Malawi. None of the countries imported fertilizer in bulk.

22. In 1976, about 18 percent of the 18 countries' fertilizer requirements were produced in Africa. Tanzania's plant supplied 75 percent of national requirements.

C. The high cost of fertilizers delivered to farmers

23. Fertilizer use in many countries in Africa is discouraged by the very high cost to the farmers. The price farmers pay in such land-locked countries as Rwanda, Burundi, the Sahelian region and Central Africa is two or three times the price of the port of dispatch in, say, Europe. For seaboard countries, the situation is distinctly better, but nevertheless, delivered prices are high particularly in East Africa (see Table 2).

24. One reason prices are high is the lack of facilities in African ports to handle shipments in bulk. The cost of shipping fertilizer in cargoes of 5,000 to 10,000 tons from European and Japanese ports would normally be about US $ 30 per ton, giving a landed price of about US $ 175 per ton for bagged urea that sells in the home market of US $ 145 per ton. Yet the survey found that deliveries of large lots of fertilizer on a 'CIF Free Out' basis and those of small lots (less than 500 tons) shipped on 'liner term discharge' are currently costing US $ 200 to US $ 245 per ton. These costs reflect the substantial delays being encountered in the off-loading and inland forwarding of fertilizer materials due to severe congestion in most of the ports and deficiencies in the railway system.

25. The second reason why delivered fertilizer prices are high is the high cost of inland forwarding. This adds between 40 percent and 100 percent to the landed price, depending on the distance to be covered by rail and/or road. These costs bear particularly heavily on the land-locked countries which have no means to introduce improvements in port and transport operations in other countries.

26. As a result of the high cost of sea and inland transportation, fertilizers have to be subsidized heavily to achieve a favourable cost/benefit relation; this is often the case, even for high value export crops. Many countries covered by the survey lack sufficient means to finance such subsidies; they therefore rely on foreign assistance to finance fertilizer imports. This is a short term measure.

27. In the long term, these countries need to manufacture fertilizers themselves from locally available energy or raw material sources. The cost of producing fertilizers on such a small scale from local raw materials will be high; but the survey shows that local manufacture could be competitive with the very high cost of imported fertilizer products.

II. Investment Opportunities in the Least-Developed Countries

A. Bulk-blending/bagging of fertilizers imported in bulk

28. Bulk-blending offers a potential cost-saving to those countries with a suitable climat where a captive market for compound mult -nutrient fertilizers exists and where the facilities to receive and transport imports of fertilizers in bulk are available. The economics of bulk-blending need to be determined for each individual country situation to see whether local blending and bagging would be cheaper than imports of finished NPK products. Generally, there should be a captive market of at least 10,000 tons of compound fertilizers a year to justify the installation of bulk-blending facilities in any country.

29. It is technically feasible to install bulk-blending facilities of any capacity. In practice, the size of the mixing unit will be determined by the high degree of standardization in plant capacities and design, as practised in this field of engineering and contracting business.

30. Thus a plant producing 10,000 tons of multi-nutrient fertilizers a year is the minimum size of a blending unit that can be recommended; it should have a rated capacity of 10 tons/hour (effective operational output 5 tons/hour, giving an annual output of some 10,000 tons, on the basis of one shift of 8 hours per day and 250 on-stream days).

31. Investment costs are about US $ 10,000 per ton of installed capacity for a unit with 10 tons/hour of rated capacity. Investment costs for a 40 tons/hour unit amount to some US $ 7,000 per ton of installed capacity. Common standard-size units range in rated capacity from 10 to 40 tons per hour (operational output from 5 to 20 tons/hour).

Savings obtainable from transporting fertilizers in bulk shipments

32. Transport of fertilizers in bulk is cheaper than shipping fertilizers in bags, in particular for shipments that require to be forwarded inland after their sea journey. For shipment in bags, ocean freights between Europe and the African continent are US $ 25 - 30 per ton for large lots (8,000 - 10,000 tons) and US $ 45 - 70 per ton for small lots (300 - 3,500 tons) shipped on liner term discharge. The cost of shipping large lots could be reduced by US $ 10 - 15 per ton if the fertilizers are transported in bulk and loading/discharge rates of 2,000 tons per day can be achieved. Most African ports could and do receive shiploads of up to 10,000 tons, but many do not have the equipment to handle and to store such tonnage of

fertilizers if they were to be supplied in bulk. In addition, railways in general are not well equipped to move such large shipments inland.

33. Countries with deep-water ports can take advantage of favourable ocean freight for bulk shipments if they install the appropriate handling and storage facilities. Most of the existing (and planned) fertilizer plants in West and East Africa are located near ocean ports and have facilities to handle shipments of fertilizers in bulk.

34. On the other hand, the economic advantage of shipping fertilizer in bulk are less attractive and cannot be applied when the establishment of bulk-blending facilities in land-locked countries is considered. Transport of materials in bulk over long distances inland by truck can only be recommended for countries where there are suitable roads and transportation infrastructure. A connecting railway system equipped with special wagons to transport bulk materials to the port and fertilizers up-country is needed. A capacity to transport fertilizers inland at rates exceeding 1,000 tons a day, for example, will become available in Upper Volta in the early 1980s to ship ore to the coast. Similar railway projects may facilitate bulk shipments of fertilizer in other African countries.

Opportunities for bagging fertilizers in least-developed countries

35. Closely related to the transport of fertilizers in bulk, is the possibility of local bagging of imported bulk fertilizer materials. A gross reduction of US $ 20 - 21 per ton may be achieved in the cost of fertilizer supplied. Against this must be charged the local cost of bags and labour to fill them. Where bags can be filled manually or semi-automatically, a net saving in foreign currency of about US $ 17 - 18 per ton and an overall cost reduction of about US $ 10 - 12 can be achieved.

36. In summary, bulk-blending is most likely to be a viable operation in countries which have a local market for compound fertilizers of at least 10,000 tons a year and which have the infrastructural facilities to import the required fertilizers in bulk. In this case, savings of up to US $ 20 - 25 per ton achieved by importing fertilizers in bulk can be expected to cover the fixed and operating costs associated with the local bulk-blending and bagging operations.

37. Among the 18 African countries covered by the survey, Malawi and Lesotho already have bulk-blending/granulation facilities. In Somalia, Benin, Ethiopia and Guinea, and perhaps later on in Upper Volta, there appears to be an opportunity to invest in such facilities.

Opportunities for the Local Manufacture of Fertilizers

38. Tanzania is the only country among the 18 least-developed countries in Africa that manufactures fertilizers. Production costs are high because the raw materials such as ammonia, phosphate rock, sulphur (and also potash) have to be imported from overseas.

39. Sudan has firm plans to establish an ammonia/urea complex based on naphtha to be supplied by the local refinery which is scheduled for operation by 1982. The plant's capacity is expected to be sufficient to meet most of the country's needs for urea up to the mid 1980s. By locating near the centre of consumption, the delivered cost of fertilizer is expected to match the cost of imported urea which faces a long and expensive inland journey.

40. For the other African countries, and in particular the land-locked ones where fertilizer supplies are expensive and unreliable because of long transport routes, manufacture of fertilizer from local energy and raw material resources should be considered. Malawi, Rwanda and Chad have the resources to produce nitrogenous fertilizers, Malawi, Burundi, the Central African Empire, Mali, Upper Volta, Benin and Niger have all or most of the raw materials to produce phosphate fertilizers.

41. In most of these countries, the initial scale of production would have to be small and consequently the cost of production would be high relative to international standards. Nevertheless production costs, even for the smallest manufacturing units could turn out to be lower than the delivered cost of imported fertilizers which fall in the range of US $ 300 - 700 per ton of the nutrients N and P_2O_5.

42. Feasibility studies should be undertaken to demonstrate the viability of the projects identified about in paragraphs 37 and 40, with international co-operation.

III. Investment Costs of Fertilizer Plants that might be Established

A. Bulk-blending/bagging plants

43. The installation of bulk-blending cum bagging facilities with a rated capacity of 10 to 40 tons per hour (effective output 5 to 20 tons/hour) will involve a capital investment between US $ 500,000 and 1,000,000. The cost of equipment and machinery, delivered and erected at the site will amount to between US $ 200,000 and US $ 400,000; this constitutes the main foreign exchange component of the total cost. The cost of site preparation,

civil engineering and off-site facilities include facilities to store 3-months' supply of intermediate materials and finished products, make up the balance of the investment required.

44. Corresponding capital requirements for each of the countries qualifying for investment in bulk-blending operations work out as follows:

Country	Proposed rated capacity tons/hour	Investment required
Benin	10	US $ 500,000
Somalia	10	US $ 450,000
Ethiopia	50	US $ 2,600,000
Upper Volta	20	US $ 650,000
Mali	20	US $ 600,000

In Ethiopia, investment in port handling facilities and facilities to transport fertilizer to the plant site are included.

B. Local manufacture of phosphate fertilizers

45. Land-locked countries like Mali, Upper Volta, Malawi, Burundi have phosphate rock which can be used to establish a plant to manufacture phosphate fertilizers. The size of the local market in those countries would initially justify only a small scale operation to produce single superphosphate (18 - 20% P_2O_5).

46. Total investment costs for installing a unit producing SSP at a rate of 20,000 tons per year (70 metric tons/day) from local rock and imported sulphuric acid, would be in the range of US $ 1.6 million to US $ 4.5 million, if sulphuric acid is to be produced locally. These figures cover site preparation, civil engineering, cost of equipment and materials delivered and erected, as well as off-site facilities including rock grinding and storage buildings; they do not include installations for product granulation.

C. Local manufacture of nitrogenous fertilizer

47. The installation of a small ammonia unit with a design capacity of 100 metric tons/day would at present require an investment of US $ 30 - 35 million if it were to be based on natural gas feedstock as proposed for Chad and Rwanda, and perhaps between US $ 50 million and US $ 70 million, if electrolytic hydrogen or coal were used as the feedstock, as for example is being considered in Malawi.

D. Cost of feasibility studies

48. The viability of such local manufacturing projects can only be established by a detailed feasibility study in each country, costing approximately US $ 100,000 to US $ 150,000.

TABLE I

CONSUMPTION OF FERTILIZERS IN 24 LEAST-DEVELOPED COUNTRIES

(tons of fertilizer materials are reported)

Country	1975 Population	1976 Cultivated area	1976 Consumption per hectare	Actual 1976 Consumption total	Actual 1976 Consumption compounds	Forecast 1980 Consumption total	Forecast 1980 Consumption compounds
	MM	TH.Ha.	kgm.	m.tons	m.tons	m.tons	m.tons
AFRICA							
Benin	3.0	1200	7.1	8,500	5,500	15,000	10,000
Botswana	0.3	280	25.8	7,500	n. a.	10,000	n. a.
Burundi	3.7	2200	1.1	2,500	1,400	3,000	1,700
Cape Verde	0.3	58	5.1	300	n. a.	1,200	500
Central African Empire	2.0	2000	1.1	2,100	1,000	4,000	2,000
Chad	4.0	1447	10.8	15,500	12,000	26,000	21,000
Ethiopia	27.9	7900	5.0	52,000	40,000	195,000	130,000
Gambia	0.5	194	18.9	3,700	500	9,000	1,000
Guinea	4.4	4170	0.7	3,000	n. a.	5,000	n. a.
Lesotho	1.0	340	19.1	6,500	6,000	8,000	n. a.
Malawi	5.4	1908	35.8	68,000	28,000	100,000	40,000
Mali	5.6	1782	12.4	22,000	14,500	54,000	25,000
Niger	4.6	2604	1.2	3,000	-	9,000	2,500
Rwanda	4.1	1250	2.4	3,000	800	4,500	1,000
Somalia	3.1	675	28.4	19,000	9,000	29,000	15,000
Sudan	17.7	4800	35.0	168,500	-	202,500	-
Tanzania	15.3	2867	5.6	94,000	26,000	150,000	40,000
Upper Volta	6.0	2403	2.9	9,000	6,000	18,000	12,000
TOTAL 1/				490,000	150,000	845,000	300,000
ASIA ABD MIDDLE EAST							
Afghanistan	19.2	4800	47.6	70,000	n. a.	165,000	60,000
Bangladesh	76.8	12500	42.4	456,000	n. a.	650,000	n. a.
Nepal	12.5	3000	12.6	37,800	15,100	38,000	n. a.
Yemen Arab Republic	.6	1520	6.0	9,000	3,000	27,000	9,000
Yemen Democratic	1.6	57	49.0	2,500	n. a.	6,000	n. a.

Total may not add due to rounding.

TABLE 2

Price Build-up of Fertilizer Supplies Delivered to Customer

(in US $ per ton of bagged urea)

Country	Year	FOB Europe	Landed C+FFO	Landed CIF Liner	Delivered central warehouse interior	Cost price customer
AFRICA						
Benin	1976	110-120	-	210	290	-
Burundi	1978	135-145	-	245	367	395
Central African Empire	1978	135-145	-	263	330	390
Chad	1976	110-120	144	-	280	290
Ethiopia	1976	220	-	-	275	327
Gambia	1976	110-120	140	-	164	-
Guinea	1978	135-145	-	-	-	-
Malawi	1978	135-145	200	-	230	-
Mali	1976	110-120	140	-	280	300
Niger	1976	110-120	140	-	288	-
Rwanda	1978	135-145	-	245	475	545
Somalia	1978	135-145	190	-	-	232
Sudan	1978	135-145	200	-	302	-
Tansania	--	-	-	-	-	-
Upper Volta	1976	110-120	140	-	284	298
ASIA						
Afghanistan	1978	130(DAP)	160	-	-	-
Bangladesh	1978	125(TSP)	160	-	-	-
Yemen Arab Republic	1978	130	160(TSP)	-	-	244
Yemen Democratic	1978	-	185(urea)	-	-	270

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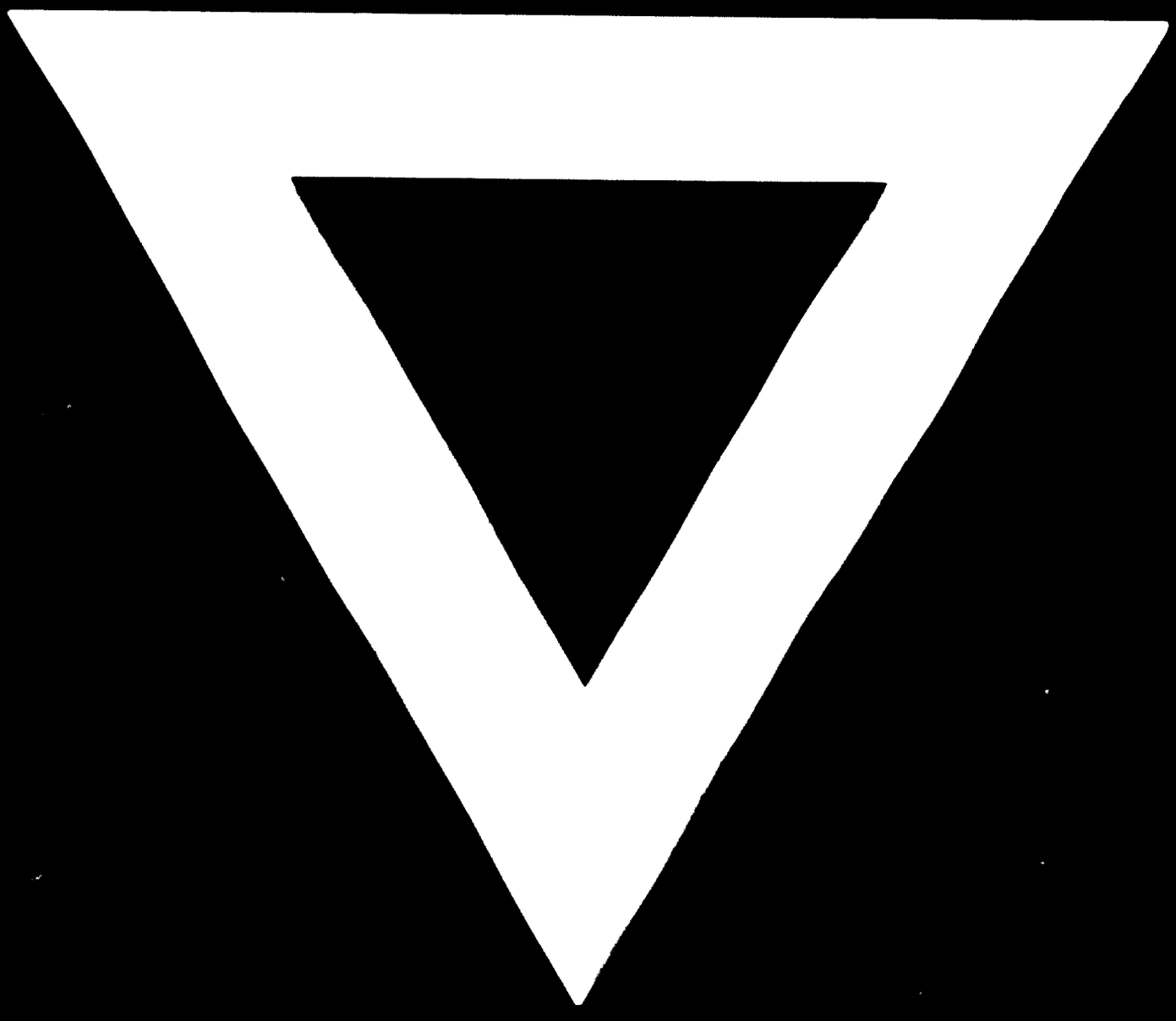

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