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**Expert Working Group Meeting  
on the Production of Panels  
from Agricultural Wastes**

**Vienna, Austria, 14 - 18 December 1970**

**REPORT OF  
THE EXPERT WORKING GROUP MEETING  
ON THE PRODUCTION OF PANELS  
FROM AGRICULTURAL WASTES** ✓

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We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche.

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## I. INTRODUCTION

### Background

1. Many developing countries, though not self-sufficient in wood and wood products, have great quantities of agricultural residues and non-wood fibrous materials which more often than not they fail to utilize.
2. In order to assist those developing countries in finding substitutes for wood-based products, thereby reducing the need to import this vital product, UNIDO convened an Expert Group Meeting on the Production of Panels from Agricultural Residues.

### Terms of reference

3. The terms of reference of this group were set out as:
  - a) To compile the past experience acquired in the utilisation of agricultural wastes and non-wood fibrous materials in the production of panels, indicating the potential materials that have been found suitable, and those that have not;
  - b) To outline the research that has still to be carried out on certain potential raw materials common to developing countries, in order to determine their suitability for use in the production of panels;
  - c) To investigate the economic and technological aspects of producing various types of panels from these materials, and highlight those prerequisites that are needed to ensure the viability of such industries in the developing countries;
  - d) To formulate in the recommendations contained in their report, all measures which the developing countries have to take to utilise more fully their potential raw materials as substitutes of hitherto imported wood-based panels.

### Organisation

4. The meeting was organised by the United Nations Industrial Development Organisation and was intended to bring together participants from developing and developed countries at UNIDO's expense. The experts invited were either closely associated with research on these problems or managers of plants producing panels from agricultural residues and non-wood fibrous materials. Observers who fulfilled the above requirements also attended and actively participated in the meeting which was held in the Ratsaal of the Neue Hofburg, Vienna.

Austria from 14 to 16 December 1970. Mr. A. V. Fassili of the Light Industries Section of the Industrial Technology Division of UNIDO acted as Secretary to the meeting.

#### Opening of the meeting

5. The meeting was opened by Mr. E. G. Rothblum, Assistant Director of the Industrial Technology Division (on behalf of Mr. I. H. Abdel Rahman, Executive Director of UNIDO), who made a statement which has been reproduced as Annex I to the present report. An address of welcome was also given by Mr. W. Moreira-Dias, Officer-in-Charge of the Light Industries Section.

#### Attendance

6. The meeting was attended by: seventeen experts from the following countries: Austria, Belgium, Cuba, Czechoslovakia, Federal Republic of Germany, France, Iran, Norway, Peru, Poland, Thailand, the United Arab Republic and the United Kingdom.

7. Twenty four observers: Austria, Belgium, Federal Republic of Germany, France, Iraq, Morocco, Netherlands, Norway, Saudi Arabia and Sweden.

A complete list of names and addresses of the participants and observers is given in Annex 2.

#### Election of officers

8. Mr. Mohamed H. Tantawi, Director and General Manager, Société des Sucrieries et Distillerie d'Egypte, Cairo, U.A.R. was elected Chairman; Mr. Torsten J. Mosesson, Director, Tomo Trading Co. Ltd., Uxbridge, United Kingdom was elected Vice-Chairman and Mr. Arnost Travník, Lecturer, Lignoprojekt, Bratislava, Czechoslovakia was elected Rapporteur.

#### Adoption of the agenda

9. At its first session, the work programme and agenda, as reproduced in Annex 3, were unanimously adopted. However, the Expert Group decided to change the title of the meeting from "~~Expert Group on Production of Panels from Agricultural Wastes~~" to "Expert Group on Production of Panels from Agricultural Residues" as it was felt that the word "wastes" could be interpreted as being pejorative, thus possibly evoking consumer resistance to panels manufactured from these materials. The group stressed that the quality of the product was the only valid criterion when selecting a panel for a given end use. The group was of the opinion that people concerned with specifications should not be influenced by the raw material used

in the manufacturing process.

#### Documentation and working languages

10. Twelve documents dealing with various topics related to items on the agenda were commissioned by UNIDO. Two Conference Room documents were submitted by participants. A list of these documents is given in Annex 4.<sup>1/</sup>

11. Although the documents were only distributed in the languages in which they had been written (English and French), summaries in English, French and Spanish were made available to participants.

12. English, French and Spanish were the official working languages of the meeting.

#### Adoption of the report

13. At its closing session held on 18 December 1970, the expert group unanimously approved the draft report of the discussions that had taken place. The recommendations formulated and variously amended by the experts were carefully considered and unanimously approved.

14. In adopting the Report of the Expert Group recommend that UNIDO make it available to the following bodies in developing countries, over and above its normal channels of distribution: industrial development corporations and banks, industrial research and building research institutes, and chambers of industry.

15. It was considered that this would materially assist the establishment of industries producing panels from agricultural residues and increase their consumption. It was also felt that this step would encourage the governments, industries, institutions and individuals concerned to implement the recommendations the group had made.

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<sup>1/</sup> A limited number of copies of these documents and their summaries in English, French or Spanish are available and may be requested from the UNIDO Industrial Documentation Centre, P. O. Box 707, 1011 Vienna, Austria.

## II. DISCUSSIONS

### Historical outline of past research on the production of boards from agricultural wastes and future trends

16. The study group took note of the paper prepared by Mr. Chittenden entitled "Historical outline of past research on the production of boards from agricultural wastes and future trends" (ID/WG.83/2) and the paper submitted jointly by Messrs. Eisner and Travnik on "Some experiences on research and manufacture of panels from agricultural wastes and non-wood fibrous materials in Czechoslovakia" (ID/WG.83/CR.2). It was recommended that tables I and III presented in the paper ID/WG.83/2 be updated to include capacity figures for 1970.

17. The group requested UNIDO to compile, update and make available to all interested bodies and individuals in developing countries a bibliography on the research carried out into the utilization of agricultural residues and non-wood fibrous material for the production of panels.

18. It was noted that in certain cases the economic benefit of establishing a local panel industry was also curtailed by the burden on the national economy incurred by importing resins.

19. In view of the conditions prevailing in developing countries where markets are small partly due to the lack of experience in utilizing the boards, and the possibility of establishing regional plants is limited, the study group drew the attention of prospective investors to the need for adequate documentation. It was recommended that comprehensive documentation should be prepared, featuring the following items:

- a) concise instructions relating to market research and feasibility studies;
- b) adequately sized samples of various panels with a brief description of their properties and potential end-uses. The data thus compiled should serve as basis for estimates of future consumption of specific assortments such as:
  - standard density particle board for general use in accordance with world standards
  - particle board with smooth surfaces and a high degree of tensile strength perpendicular to the surface, suitable for veneering or laminating
  - particle board, bonded with moisture-resistant adhesive, for building



and similar purposes

- thin particle board for packaging and ceilings
  - boards made from particles and bonded with cement for building purposes
  - hardboards
  - semi-hard fibreboard for both the furniture and building industries
  - medium density fibreboard for thermal and sound insulation purposes
- c) concise technological descriptions of the particle board and fibreboard manufacturing processes (wet and dry), including a simple production layout with equipment specifications and a breakdown of approximate production costs as guidelines. In this connexion and in view of the conditions prevailing in the majority of developing countries, the study group agreed that one of the following capacities could be taken as a basis for a preliminary feasibility study: 10,000 cu.m particle board, 15,000 tons hard fibreboard, and 100,000 sq.m cement-bonded boards made from agricultural residues;
- d) guidelines relating to the promotion of panels and their utilisation, including instructions for quality control and suggestions as to their further processing.

20. From a purely technical standpoint, the study group classified the available raw material as follows:

- a) flax shives and hemp shives are highly suitable for the production of low and medium density particle boards. It was felt that the diminishing production of such boards in certain European countries was not due to consumer resistance, but rather to the insufficient supply of raw materials. Bagasse has also proved to be suitable for the production of particle boards, fibreboards, pulp and certain kinds of paper. Cereal straws are being commercially processed into straw slabs and fibreboards. The technical problems arising in connexion with the processing of these materials have already been overcome. Consequently, the study group was of the opinion that in cases where adequate raw materials were available and markets existed, feasibility studies for establishing such plants could be initiated;
- b) papyrus, cassava stalks, cotton stalks, jute and kenaf, coconut palm trunks, palm fronds and fruit stems and esparte grass are agricultural wastes of certain potential value which are common to many developing

countries. Commercial experience to date, however, was felt to be insufficient. The group's attention was drawn to the fact that prior to its closure, a small-scale plant in Uganda had manufactured fibreboards using papyrus. Another plant in Iran had been utilising cotton stalks for particle boards for the last two years, while in 1970 the manufacture of moulded containers using combed esparto had been introduced in Morocco. Esparto had also been used at pilot plant level for the production of both particle boards and fibreboards. The particle boards produced in the conventional manner were not satisfactory, but the results obtained with fibreboards were more promising. Palm fronds and fruit stems have also undergone pilot-plant testing and the first plant is being erected in Iraq. Thus, in view of the above the study group recommended prospective investors to obtain expert advice and assistance from specialized institutes or international organizations prior to taking a final decision on investing;

- c) cotton seed hulls, rice husks, coffee husks, cocoa shells, coir, date palm trunks, banana stalks and sunflower seeds have so far failed to prove satisfactory for the production of particle board or fibreboard. It was felt that some of them, however, could be used as aggregate in light-weight concrete blocks and slabs.

21. It was reported that research had been carried out on other potential agricultural materials. The results, however, had not been encouraging and the study group recommended prospective investors to undertake exhaustive studies prior to investing in plants utilising such materials.

#### Technical and economic aspects of harvesting and preprocessing agricultural wastes

22. Six papers relating to various problems to be encountered in the harvesting and preprocessing of agricultural wastes were presented at the meeting, entitled as follows:

- a) "Technical and economic aspects of bagasse utilization" by Mr. M. Tantawi (ID/WG.83/9);
- b) "Economic and technical aspects of harvesting cotton stalks for the production of particle board" by Mr. E. Mahdavi (ID/WG.83/11);
- c) "Technical and economic aspects of utilization of flax and hemp shives for the production of particle boards" by Mr. A. Frackowiak (ID/WG.83/12);

- d) "Technical and economic aspects of processing rape seeds into particle boards" by Mr. W. Kilanowski (ID/WG.83/13);
- e) "Economic and technical aspects of the utilization of cereal stalks for the production of panels" by Mr. S. Bulakul (ID/WG.83/10);
- f) "Production of strawboards by the 'Stramit' process" by Mr. T. J. Mosseson (ID/WG.83/CR.1).

23. In the discussions that followed the presentations, the study group drew attention to the following general measures that have to be adopted when utilizing agricultural wastes:

- a) the importance of carefully studying the question of transportation in those cases where the agricultural residues were not a by-product of other industrial processes so as to ensure the optimum supply of raw materials,
- b) owing to their annual nature agricultural residues required larger storage areas than were customary in similar capacity plants utilizing wood as raw material;
- c) the possible risk of decay and deterioration of the raw material during storage under certain climatic conditions for it had been observed that unless the moisture content of the stacks was reduced to around 22 per cent and below fungal attack might occur;
- d) the need for adequate fire protection in all storage areas, while ample passageways should be left between stacks to permit unrestricted access in the case of fire.

#### 24. Bagasse

After discussing the problems connected to the utilization of all agricultural residues, the group then debated the various materials individually. The group remarked that the cane sugar industry, which was concentrated in countries short of wood resources, offered considerable quantities of ligno-cellulosic material which had proved to be quite suitable for the manufacture of both panels and paper. Interest had centred on sugar-cane bagasse because it was an industrial by-product of relatively low value, especially in sugar mills, where surplus bagasse is readily available. In certain cases, one sugar mill can meet a panel mill's bagasse requirements.

25. Transport problems could be reduced to a minimum if the panel mill were located next to the sugar mill. The group pointed out that mill-run bagasse contained a large fraction of non-fibrous material, the pith, which had to be removed. Moist depithing of the mill-run bagasse was felt to be the most appro-

appropriate system as the problem of pith disposal could be solved by using it as fuel in the sugar factory's steam generating plant. Before processing the dried bagasse into particle board, the pith fraction remaining should be separated pneumatically.

26. The group remarked that a panel mill should operate the whole year using stored bagasse in order to avoid excessive capital expenditure. The social problems customarily encountered in seasonal industries are thus avoided and there would be no need to store an enormous stock of panels, and the difficulty of establishing a production programme suited to actual market requirements would be overcome.

27. The group felt that a wet bulk storage system would be the most appropriate method if the bagasse was to be processed into hardboard or other types using wet forming. However, if the bagasse was to be processed into particle board, it should be sufficiently predried. Depending on the climatic conditions preference should be given to the natural drying of bagasse during storage. However, under certain climatic conditions, the bagasse to be used for particle boards would have to be dried artificially.

28. If a baling system were to be adopted for the storage of bagasse, the group emphasized that great care should be taken with regard to stack structure and the provision of adequate ventilation between the bales to prevent discoloration and destructive fermentation. It was agreed that the fuel replacement value of bagasse and baling expenses were the most expensive items, though where surplus bagasse was available, costs would be considerably lower.

#### 29. Flax and hemp shives

It was established that both raw materials after twenty years of use presented no outstanding transport or storage problems, as the plants were usually an integral sector of flax and hemp processing complexes utilizing the by-products. It had been observed that under central European conditions additional raw material could be transported over distances of up to 120 km and capacities of 15,000 cu. m to 18,000 cu.m were economically viable.

30. Pretreatment presented no problems: the raw material always had to be dried to extract fibres for the textile industry and the shives were thus obtained ready dried.

31. The group wished to draw attention to the fact that the amortization periods for the plant quoted on page 4 of the report (ID/WG.83/12) were exceptional even for Poland and could not be applied as a general rule to other countries.

32. Rape straw

Despite the fact that the cultivation of rape is only limited to a few developing countries, the group felt it pertinent to discuss the technological process for the production of particle boards from rape straw which had recently been developed. They also debated the problems of collecting and preprocessing the raw material which are similar to those of some other potential agricultural residues in various developing countries in the belief that the data quoted in the paper would serve as a guideline for similar cases.

33. The group was informed that studies relating to the economics of production had shown that plants producing 15,000 cu. m or 9,000 tons per annum were economically viable in Poland provided that no less than 6 per cent of all the land within a radius of 60 km be planted with rape.

34. Jute and kenaf sticks

The group wished to attract the attention of jute producers to the fact that jute sticks were good potential raw material for the production of particle boards. They are already being used commercially in a plant in Pakistan.

35. Kenaf sticks of Asian origin were also potential raw materials for particle boards and the group agreed that no outstanding technical problems in preprocessing remained to be solved.

36. Cotton stalks

One of the papers submitted (ID/WG.83/11) supplied details on the utilization of cotton stalks as a raw material for a particle board plant in Iran. It was reported that the plant was utilizing this raw material successfully, the stalks being harvested locally by manual labour (20 - 30 km from the plant). The raw material was transported in bulk without prior baling or chipping in the field (partly with husks). The yield obtained during processing was very low (33 per cent); the factory gate price of cotton stalks was half of that of the alternative material (poplar).

37. The group concluded that the utilization of cotton stalks was governed by the following considerations. In certain cotton growing areas, cotton stalks have to be burnt to prevent the spread of cotton worm and other insects. In Iran where such measures are not mandatory, the stalks have to be treated with insecticide which costs about US \$1 per ton of stalks. The group felt that the possibility of chipping the stalks in the field would have to be investigated, thus lowering transport and storage costs as well as reducing the fire risk.

38. Cereal stalks

The group remarked that rice, wheat and barley were often under intensive cultivation. It was observed that the raw material, while being unsuitable for the production of particle board, was being used for fibreboard and straw slabs. In certain cases the cereal stalks were underutilized.

39. It was felt that the harvesting and collection thereof, whether manual or mechanical, could be organized to ensure regular supplies. Baling in the field was recommended as long as the moisture content (on a wet basis) did not exceed 22 per cent to prevent decay. Nevertheless, for processing purposes, the straw moisture content should be between 13 and 16 per cent.

Technical processes for the production of various types of panels from agricultural wastes

40. The following papers were devoted to the above subject:

- a) "Particle board from annual plant wastes" by Mr. M. Mestdagh (ID/WG.83/5)
- b) "Technical and economic aspects of the production of particle board from rape straw" by Mr. N. Kilanowski (ID/WG.83/13);
- c) "The dry process for the production of fibreboards" by Mr. M. Lepout (ID/WG.83.6);
- d) "Technical processes for the production of wood-wool/cement boards and their adaptation for the utilization of agricultural wastes" by Mr. W. Sandermann (ID/WG.83/4);
- e) "Economic and technical aspects of the utilization of cereal stalks for the production of panels" by Mr. S. Bulakul (ID/WG.83/10);
- f) "Production of strawboards by the 'Stramit' process" by Mr. J. Mesessen (ID/WG.83/CR.1).

41. In the ensuing discussion it transpired that the investigations carried out by research laboratories into a large number of vegetable plants had shown that certain types of panels could be produced from some of the raw materials. However, work remained to be done on other raw materials as there was a tendency to extrapolate results and deduce that these raw materials presented no specific problems.

42. It was remarked that regardless of the agricultural waste tested, current knowledge of methods and processes for its agglomeration had proved that panels could be obtained by different methods. These different methods, however, would not automatically yield products whose technological qualities were always comparable. Experience had shown that the success or failure of a pro-

ject depended to a large extent upon the correct choice of process, and consequently upon the products manufactured and their properties. As an illustration, it was pointed out that the products obtained from **anyone** agricultural waste material could have totally different technological properties depending on whether the panel or slab produced was:

- a) parvicle board, flat pressed or extruded; (in the former case properties could vary depending on whether the panel was mono-layer, three layer, or multi-layer);
- b) fibreboard, produced either by the wet or dry process;
- c) a panel bound by mineral binders (of the wood wool-cement and wood shavings type);
- d) an extruded panel manufactured from stalks of cereal plants.

43. Consequently, the group recommended that feasibility studies be prepared by impartial specialists on the basis of detailed questionnaires supplied by the promoter of the project, containing:

- a) detailed technical data on the proposed raw material;
- b) marketing prospects - including those for competitive products;
- c) socio-economic aspects;
- d) required infrastructure costs;
- e) detailed analysis of the performance of the material with respect to the end-uses envisaged in the market survey carried out under (b).

44. The group also recommended that investors employ the services of an impartial specialist to advise on the preparation of calls to tender, the selection of bids and the setting up of trial runs.

45. Assistance from bilateral or multilateral organisations offering aid could be sought whenever appropriate.

46. The group also drew the attention of interested parties in the developing countries to the fact that the preparation of detailed studies facilitated the examination of projects by prospective investors.

47. The group recommended that key technical personnel be trained to ensure the efficient operation of the plant upon opening. It was of the opinion that the satisfactory operation of a panel plant depended essentially upon the competence from the very outset of the persons in the following positions: technologist (who could also be the production manager), a highly skilled electrician and a highly skilled mechanic.

48. The group strongly recommended that prospective investors in the developing countries devote particular attention to a regular control of both the process and the quality of the finished products so as to ensure the maintenance of standards. Consequently, a control laboratory containing all the essential equipment should be included in the project.

49. The group recommended that UNCTAD consider extending in its programme of technical assistance fellowships to key production personnel from panel plants in developing countries so that they might be trained in modern production and process control operations and plant maintenance.

50. The group's opinion was sought on the feasibility of producing building materials from agricultural residues on a village-industry or intermediate technology scale. At the present moment, the group saw no solution to this problem, but several speakers ventured the need for further work to be done on the feasibility of the small-scale manufacture of boards.

51. Particle boards

It was pointed out that the major part of the information acquired in the utilization of agricultural wastes in the production of particle boards was related to flat pressed boards.

52. The group pointed out that in order to attain an economically viable production capacity (of the order of 10,000 cu. m yearly based on 2-shift operations), and bearing in mind the smallness of local markets in most developing countries, the diversification of products should be envisaged. The group felt that a two-shift operation was the minimum from an economic standpoint. An adequate degree of mechanization of the production line was necessary to minimize fluctuations in quality and to lower production costs.

53. In view of the fact that the furniture industry in certain developing countries was often still at a craftsman stage, equipment for the surface finishing of the boards should be provided at the panel plant so as to facilitate the introduction of the products on the local markets.

54. For similar reasons, the possibility of producing panels resistant to local climatic conditions should be envisaged, thus facilitating the adoption of this product by the building industry.

55. Thus, it became increasingly evident that a certain degree of flexibility in production techniques has to be a fundamental characteristic of the production unit; a factor that had to be kept in mind when considering the cost of the plant.



#### 56. Fibreboards

The group noted that in the case of fibreboards, economies of scale play a much important role (the minimum economic capacity being of the order of 15,000 tons yearly) than in the case of particle boards. It was stressed that unlike particle board plants, those producing fibreboards must operate on a 3 shift basis. Consequently, the market study is a determinant factor in the decision to invest, and a process can only be chosen subsequent to a comprehensive study. It was also felt that the need for producing oil impregnated boards locally should be ascertained in the market survey.

57. It was observed that the respective merits of the dry and wet processes were linked with the raw material to be utilized and local conditions, both of which were the main parameters in the final choice.

#### 58. Cement-bonded slabs

Several agricultural wastes such as wheat, rice, straw, cotton stalks, corn stalks, bagasse, flax hemp, rice hulls, and coconut fibres had been tested. Some fibrous materials contained cement setting inhibitors such as sugars, hemicelluloses and tannins which had to be removed and the raw material had to be adequately pretreated prior to its utilization. Despite various claims that such problems had already been solved, commercial applications had not been started and the group believed that further research was necessary.

59. The group recommended that specialized institutes both in the developing and industrialized countries attach priority to such research in view of the boards importance in low cost housing programmes in developing countries where these slabs had been observed to greatly reduce erection times. Furthermore, this process was felt to be particularly suited to developing countries because of the simple technology, the availability of practically all raw materials locally, the smallness of the capacities of production and the possibility of utilizing labour-intensive processes.

#### 60. Straw slabs

It was felt that less sophisticated plants were of interest to developing countries as they could operate profitably on capacities as low as 2,000 tons/annum working on a single shift basis, mainly processing local raw material and producing building slabs which could be used in low-cost housing schemes.

61. The group's attention was drawn to the fact that the resin and paper that had to be imported usually represented about one-third of the total cost of production. This observation coupled with the fact that the use of labour-intensive handling methods gave rise to relatively few skilled jobs

might make the process appealing to developing countries. Another benefit was an increased regular cash crop to farmers.

62. It was pointed out that the process could be used for rice, wheat and barley straws which in certain areas were underutilized. The group wished to draw attention to the importance of testing the market prior to deciding on capacities and the establishment of a plant.

63. The slabs' fire resistance and good heat insulation qualities made them useful for housing. In tropical climates the paper liner had to be treated against fungal and termite attacks. It was pointed out, that due to their comparatively high mineral content the straws had an abrasive effect which called for care when choosing the appropriate cutting tools.

#### Problems of marketing and promotion of panels made from agricultural wastes

64. The study entitled "Problems of marketing and promotion related to the introduction on the markets of the developing countries of panels from agricultural wastes" (ID/WG.83/3) was presented to the meeting by Mr. M. de Longeaux.

65. The group felt that although this study by virtue of its title concentrated solely upon the possibility of exporting panels manufactured from agricultural wastes to developed countries, it was of particular importance to prospective investors in this branch as it enumerated the main measures to be taken in their own countries so as to ensure acceptance of the new products by local end-users and thus help to create a market.

66. The group was of the opinion that the importance of a comprehensive market study for the product to be manufactured in the developing country (and even possibly in neighbouring countries) should not be underestimated. It was stressed that it was imperative not only to undertake the study for the product to be produced, but all existing materials should also be studied and their effect on the product to be manufactured should be assessed.

67. The group pointed out that not only should the new product's properties be adequate for normal local end-uses and climatic conditions, but the market study should also investigate the possibility of finding new applications for the panels to be produced specific to local customs and needs.

68. The group attached particular importance to the inclusion of courses on the correct utilization of panels in the curricula of vocational training schools, which should be started upon receipt of panels made from the local materials. The group also highlighted the advantage of vocational schools obtaining samples produced under pilot plant conditions prior to the start of industrial

production.

69. The group recommended that special attention be devoted to the training of technical salesmen in order to promote the product for specific end-uses, to advise on correct applications and to prevent the building up of consumer resistance to the product, which in many cases could be ascribed as much to misapplication as to poor quality.

70. The group also emphasized the importance of preparing promotional material and technical documentation in their respective languages for the local end-users. The group suggested that the developing countries should approach the various manufacturers in industrial countries or their associations, both national and international, to obtain information on the different uses and applications of the panels.

71. The group recommended that producers of panels from agricultural wastes in developing countries endeavour to extend local building codes and specifications laid down by various governmental bodies and other important end-users so as to permit the utilization of locally manufactured panels whenever possible.

72. The group pointed out that, whereas the word "agricultural wastes" was acceptable technically, its use when promoting the product should be avoided as it could cast doubts on the quality of the product.

73. In view of the fact that local products produced from agricultural wastes would have to compete with wood-based panels, the group suggested that they be marketed and promoted under their trade names without specific reference to the raw material utilized.

74. In discussing the possibilities of exporting panels manufactured from agricultural wastes in developing countries to markets in industrialized countries, the group expressed the opinion that exports of fibreboards, cement-bonded boards and straw slabs were unlikely to materialize in the near future. In the case of particle board, it was felt that prospective investors should not be over-optimistic because of consumer preference in developed countries for wood-based particle boards. However, they stressed that this situation might well change because the future supply of industrial wood to the particle board plants in developed countries might decline.

75. In conclusion, the group stressed that manufacturers of panels should ensure that the technical properties of the panels are maintained throughout and that the end-users are kept informed of the panels' characteristics. It was felt that panel manufacturers should recommend the use of various types of panels on the basis of specific end-uses, while at a later stage production control by an

external body could eventually lead to the establishment of a quality label.

Selection and production of adhesives for use with agricultural wastes

76. Following the paper entitled "Synthetic resin adhesives" (ID/WG.83/8) presented by Mr. A. G. Seljestad, the meeting discussed resin costs in relation to the final cost of the board. It was generally agreed that where particle board was concerned resins represent the biggest cost element in production, the more so in developing countries. Possible means of lowering the cost of resins were discussed. The meeting noted with interest UNIDO's proposed expert group meeting on the selection of resins tentatively scheduled for 1972. The group recommended that this meeting be held as convening such a meeting would be a useful way of overcoming the problems facing glue production and its utilization, which had hitherto had a limiting influence upon the introduction and expansion of the panels industries in developing countries.

77. The group suggested that UNIDO include the following topics in the agenda for the above meeting: natural binders occurring locally; world trade in binders; mineral binders; production of chemicals used in resin production and their application to the wood processing industry; auto-agglomeration processes; and the application of surfacing materials.

78. In this respect, the group felt that the following studies should be undertaken by UNIDO or other bodies:

- a) a comparative study of binder costs in relation to raw materials and production costs in various countries;
- b) particular investigations into the problem of prolonging the shelf-life of different adhesives in hot climates;
- c) further research to be carried out by the developing countries into the use of tannin, furfural and cashew nut-shell liquid as potential substitutes for one of the resin components, as these raw materials are readily available in some developing countries and hence would help reduce the drain on foreign exchange;
- d) further research into the feasibility of transporting sulphite waste liquors in concentrated or dried form, should their use as binders for particle board prove commercially successful (reasonable pressing time, mould resistant, etc.).

79. The group wished to stress the importance of formaldehyde as an essential component in the manufacture of resin. If resins were to be produced locally in most developing countries, formaldehyde would have to be imported in a water

solution, which represented a great increase in transport costs. The group felt that the importation of paraformaldehyde in powder form would be uneconomic. In this connexion, the group discussed the possibility of producing furfural in the developing countries in order to replace the imported formaldehyde and noted with interest Cuba's work in this field.

80. The study group was informed that as a result of a recent technological development, the price of melamine might drop considerably in the not too distant future as compared with present prices.

81. The group wished to draw the attention to the fact that the establishment of industries producing particle boards from agricultural wastes has often been hampered by the high cost of resins - partly due to import duties or taxes.

#### The role and importance of standards and quality control in the development of new products

82. Following the paper entitled "Standards and quality control for panels made from agricultural wastes" presented by Mr. H. Neusser the group drew attention to the fundamental differences between testing methods and quality standards. The former are simply guidelines relating to procedure for obtaining comparable results, whereas the latter stipulate levels and certain characteristics that the product must attain if it is to be utilised for the envisaged end-uses.

83. The group also pointed out that a so-called "quality label" existed, guaranteeing that specifications had been met and that the product was suitable for certain uses.

84. In the case of developing countries, and particularly in connexion with the possible utilization of agricultural wastes, these "quality labels" should be established according to the conditions in each developing country. The group believed that in many cases internationally accepted standards were not directly applicable to the needs of the developing countries and their local markets, but they could be taken as guidelines. The potential end-uses of the panels manufactured from the different agricultural wastes depended upon the latter's physical and mechanical properties.

85. The group remarked that the equipment supplied for the production of panels from agricultural wastes should at least be comparable in quality to that used by leading panel producers in the industrialized countries.

86. The group recommended that consideration be given to the formulation of a model set of conditions relating to contracts for the supply of board making machinery to developing countries, incorporating the necessary safeguards.

### III. RECOMMENDATIONS

The expert group made the following recommendations:

#### Addressed to International Organizations

- (1) that UNIDO compile, update and make available to all interested bodies and individuals in developing countries a bibliography on the research done on the utilization of agricultural residues and non-wood fibrous material for the production of panels;
- (2) that convening an expert group meeting on the selection of resins would be a useful way of overcoming the problems facing glue production and the utilisation thereof, which had hitherto had a limiting influence upon the introduction and expansion of the panels industries in developing countries;
- (3) that UNIDO consider extending in its programme of technical assistance fellowships to key production personnel from panel plants in developing countries so that they might be trained in modern production and process control operations and plant maintenance.

#### Addressed to Specialized Institutes

- (4) that specialized institutes both in the developing and industrialized countries attach priority to research on cement-banded slabs in view of the boards' importance in low-cost housing programmes in developing countries where these slabs had been observed to greatly reduce erection times. Furthermore, the product was felt to be particularly suited to developing countries because of the simple technology, the availability of practically all raw materials locally, the smallness of the capacities of production and the possibility of utilizing labour-intensive processes;

#### Addressed to Prospective Investors

- (5) that feasibility studies be prepared by impartial specialists as the basis of detailed questionnaires supplied by the promoter of the project, containing:
  - (a) detailed technical data on the proposed raw material;
  - (b) marketing prospects - including those for competitive products;
  - (c) socio-economic aspects;
  - (d) required infrastructure costs;
  - (e) detailed analysis of the performance of the material with respect

to the end-uses envisaged in the market survey carried out under (b).

- (6) that prospective investors employ the services of an impartial specialist to advise on the preparation of calls to tender, the selection of bids and the setting up of trial runs;
- (7) expert advice and assistance be sought from specialized institutes or international organizations prior to taking a final decision on investing;
- (8) that key technical personnel be trained to ensure the efficient operation of the plant upon opening as the satisfactory operation of a panel plant depended essentially upon the competence from the very outset of the technologist (who could also be the production manager), a highly skilled electrician and a highly skilled mechanic.
- (9) that prospective investors in the developing countries devote particular attention to a regular control of both the process and the quality of the finished products so as to ensure the maintenance of standards;
- (10) that special attention be devoted to the training of technical salesmen in order to promote panels for specific end-uses, to advise on correct applications and to prevent the building up of consumer resistance to the product, which in many cases could be ascribed as much to misapplication as to poor quality;
- (11) that producers of panels from agricultural residues in developing countries endeavour to extend local building codes and specifications laid down by various governmental bodies and other important end-users so as to permit the utilization of locally manufactured panels whenever possible;
- (12) that consideration be given to the formulation of a model set of conditions relating to contracts for the supply of board making machinery to developing countries, incorporating the necessary safeguards.

ANNEX I

Statement made on behalf of the Executive Director

On behalf of the Executive Director, Mr. Abdel-Rahman, I take great pleasure in welcoming you to Vienna, to the UNIDO meeting on the production of panels from agricultural wastes.

I understand that some of you have had past contacts with UNIDO in one capacity or another, either in preparing documentation for this meeting or assisting us as technical experts in the field, while others are new to UNIDO's work. I trust that all of you will enjoy working with us and I hope your stay in Vienna will be rewarding and enjoyable.

UNIDO's essential task is to assist the developing countries in their efforts towards rapid and successful industrialization. Although most of our work consists of technical assistance to various countries in the form of field operations, meetings such as the one you are participating in is one of the means by which UNIDO seeks to meet its objectives.

Many developing countries are not self sufficient in wood and wood products; nevertheless they have large quantities of other suitable raw materials such as agricultural wastes and non-wood fibrous materials which may not be fully utilised.

The purpose of this meeting is to ask you, who are experts in the production of panels from agricultural wastes, to evaluate and assess past experiences in this field and to help us in identifying those materials that could find application in the production of panels in the developing countries. In a broader context, we hope that this will also touch upon the various problems which the developing countries must resolve in order to utilize more fully these potential raw materials which exist in most countries that are not endowed with forest resources. Needless to add that if suitable substitutes for wood based products can be identified and as a result new industries can be established, former dependence on imports can be reduced, opportunities for employment can be created, and the savings in foreign exchange used for further development.

Although many of you present are concerned with applied research in one field or another, we hope that your recommendations will be action-oriented. We also trust that your report will highlight the criteria to be chosen, and



recommend the economic prerequisites and the appropriate technology which you believe must be applied by the governmental bodies, the industrialists and entrepreneurs in the developing countries to ensure a successful introduction of new technologies and novel features in this industry.

In fact, UNIDO attaches particular significance to the technical and engineering aspects of the subject which you will treat. Through meetings such as this one, we hope to continue our role as a catalytic agent in the transfer process of technology from the advanced countries to the developing countries. In this connexion, we must remember, however, that the large scale, capital intensive and sophisticated processes which are increasingly common in industry in the developed countries need considerable adaptation prior to their application in developing countries where the markets are usually much smaller and governments anxious to train large numbers of unemployed or underemployed workers. Moreover, we must not forget that there are potentially useful agricultural wastes which exist only in the developing countries, and for which technological processes may not as yet have been developed. Furthermore, you may conclude that in assessing market requirements the quality of the products need not necessarily be the same in the developing countries as is required in the developed countries for some of the more sophisticated end-uses that may not have immediate applicability in developing countries as yet. We also hope that you will focus on potential pitfalls which the developing countries will have to avoid if they are to successfully introduce the technology of the developed countries; mistakes are particularly costly in the early stages of development. Finally, we do not have to point out that conditions and priorities vary considerably from one developing country to another.

In summary, we will welcome any recommendations you care to make that would be applicable to our technical assistance programme and which would accelerate the development of this industrial sector in the developing countries.

It would be obviously premature to anticipate at this early juncture the type of recommendations that will emerge from your discussions, or the need for UNIDO's follow-up action. However, it might be appropriate to emphasize that we in UNIDO devote just as much attention to the follow-up action resulting from the meeting as to the meeting itself. We do not consider meetings such as this one as isolated events in themselves, but as starting points for a series of measures within the scope of our technical assistance programmes and

I hope that we can continue to count on your support in these follow-up activities.

In conclusion, I wish to thank you for being here today. I am very much aware of the fact that you have left positions of responsibility to attend this meeting and I hope your stay in Vienna will be pleasant and your deliberations fruitful.

Thank you.

ANNEX II

Agenda

1. Opening of the meeting and adoption of the agenda.
2. Election of the Chairman and Rapporteur.
3. Historical outline of past research on the production of panels from agricultural wastes and future trends.
4. Economic and technical aspects of harvesting various agricultural wastes.
5. Technical processes for the production of various types of panels and their adaption to agricultural wastes.
6. Problems of marketing and promotion of panels made from agricultural wastes.
7. Selection and production of adhesives for use with agricultural wastes.
8. The role and importance of standards and quality control in the development of new products.
9. Adoption of the report.

ANNEX III

List of participants and observers

Participants

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Mr. Roger RIBIERRE	Chief Inspector Office of Control and Export	Ave. de Forces Armées Royales Casablanca
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<u>UNIDO Secretariat</u>		
A. V. Bassili	Industrial Development Officer Light Industries Section Industrial Technology Division	

ANNEX IV

List of documents<sup>2/</sup>

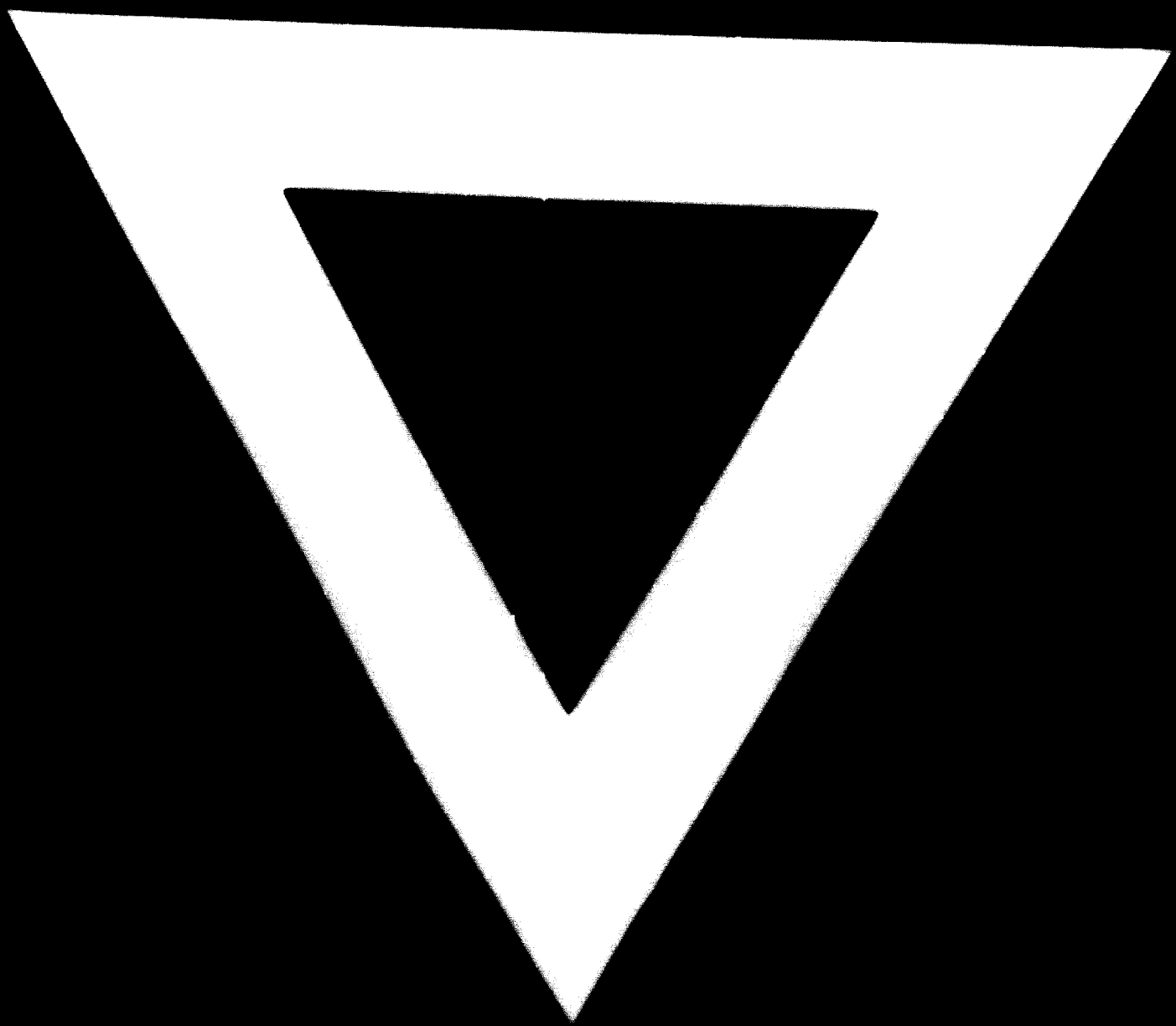
<u>Symbol</u>	<u>Title</u>
ID/WG.83/1	Provisional agenda and programme of work
ID/WG.83/2	Historical outline of past research on the production of boards from agricultural wastes and future trends (document prepared by Mr. A. E. Chittenden, Tropical Products Institute, Abingdon, Great Britain)
ID/WG.83/3	Study of marketing and promotion problems relating to the introduction of panels produced from agricultural wastes into the markets of developed countries (document prepared by Mr. M. de Longeaux, Honorary President, European Federation of Particleboard Producers' Association, FESYP)
ID/WG.83/4	Technical processes for the production of wood-wool/cement boards and their adaption for the utilization of agricultural wastes (document prepared by Mr. W. Sandermann, Federal Research Organization for Forestry and Forest Products, Reinbek, Hamburg, Federal Republic of Germany)
ID/WG.83/4/Corr.1	Corrigendum relating to above paper
ID/WG.83/5	Particle board from annual plant wastes (document prepared by Mr. M. Mestdagh, S. A. Verkor N.V., Lauwe, Belgium)
ID/WG.83/6	The dry process for the production of fibreboard (document prepared by Mr. M. Lepeut, CIPAL S.A., Paris, France)
ID/WG.83/7	Standards and quality control for panels made from agricultural wastes (document prepared by Mr. H. Neusser, Austrian Wood Research Institute, Vienna, Austria)
ID/WG.83/7/Corr.1	Corrigenda relating to above paper
ID/WG.83/8	Synthetic resin adhesives: A survey of production techniques and world trade (document prepared by Mr. A. G. Seljestad, Norsk Sprengstoffindustri A/S, Oslo, Norway)
ID/WG.83/9	Technical and economic aspects of bagasse utilization (document prepared by Mr. M. H. Tantawi, Société des Sucreries et Distillerie d'Egypte, Cairo, U.A.R.)
ID/WG.83/9/Corr.1	Corrigenda relating to above paper

<sup>2/</sup> A limited number of copies of these documents are available in the language in which they were presented (English or French) and may be requested from the UNIDO Industrial Documentation Centre, P.O.B. 707, 1010 Vienna, Austria. Summaries of the papers in English, French and Spanish may also be requested from the same source.

- ID/WG.83/9/Corr. 2      Corrigendum relating to above paper
- ID/WG.83/10              Economic and technical aspects of the utilization of cereal stalks for the production of panels (document prepared by Mr. S. Bulakul, Stramit Board Company Ltd., Bangkok, Thailand)
- ID/WG.83/10/Corr.1      Corrigendum relating to above paper
- ID/WG.83/11              Economic and technical aspects of harvesting cotton stalks for the production of particle board (document prepared by Mr. E. Mahdavi, Gorgan S.A. Gorgan, Iran)
- ID/WG.83/11/Corr.1      Corrigenda relating to above paper
- ID/WG.83/12              Economic and technical aspects of the utilization of flax shives as a raw material for the production of particle boards (document prepared by Mr. A. Frackowiak, Institute for Bast Fibres, Poznan, Poland)
- ID/WG.83/13              Economic and technical aspects of the processing of rape straw into particle boards (document prepared by Mr. W. Kilanowski, Institute for Bast Fibres, Poznan, Poland)
- ID/WG.83/13/Corr.1      Corrigendum relating to above paper
- ID/WG.83/14              List of participants
- ID/WG.83/15              Report of the expert group meeting on production of panels from agricultural residues
- ID/WG.83/CR.1            Production of strawboards by the "Stramit" process (document prepared by Mr. T. J. Mosesson, Tomo Trading Co. Ltd., Uxbridge, Great Britain)
- ID/WG.83/CR.2            Some experiments in research and manufacture of panels from agricultural wastes and non-wood fibrous raw materials in Czechoslovakia (document prepared jointly by Mr. K. Eisner, University College of Forestry and Wood Technology, Zvolen; and Mr. A. Travnik, Lignoprojekt, Bratislava, Czechoslovakia)







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