

CHINESE-AMERICAN
JOINT COMMISSION ON RURAL RECONSTRUCTION

Forestry Series: No. 4

A FORESTRY PROGRAM FOR TAIWAN

by

Tom Gill, H. D. Cochran, and E. L. Demmon



TAIPEI, TAIWAN, CHINA

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Preface

By Chiang Monlin, Chairman
Joint Commission on Rural Reconstruction

The Chinese-American Joint Commission on Rural Reconstruction has been actively engaged in a forestry development program since 1951. In June 1951 it published Forestry Series No. 1, entitled "Forest Conditions in Taiwan", by Paul Zehngraft. The report brought up to date the prevailing situation and outlined a development program to be participated in by the JCRR. A Forestry Division was established under the Joint Commission in November of that year and a program started.

It was evident from the beginning that in order to carry out the program effectively on a long-range basis, certain changes in the existing forest policy were necessary. To this end the Joint Commission in November 1952 obtained the services of Dr. Tom Gill, a world-known authority on forest policy. His studies resulted in Forestry Series No. 2, entitled "Forest Policy and Program for Taiwan", by Tom Gill. It contained a statement of proposed basic policy, outlined the principles of a forestry program, and concluded with a number of recommendations, some of which have been put into effect.

One of the recommendations of these two reports was for a Forest Survey, in order that the Taiwan Forest Administration might have accurate data regarding the location, area, composition, total volume, growth and drain of its forests, as well as information on forest industries and land use throughout the island. In the light of information brought out by this Survey, which was completed in 1956, resulting in Forestry Series No. 3, "Forest Resources of Taiwan", by George E. Doverspike, Paul Zehngraft, and Hsing-chi Yuan, the Chinese Government felt it advisable to reappraise the entire forest situation and formulate a national policy and overall management plan for Taiwan.

To this end JCRR again secured the services of Dr. Tom Gill, together with H. D. Cochran and E. L. Demmon, all three American foresters of wide experience, to work with forest officials in Taiwan. The results of these studies are embodied in this publication. Part I, prepared by Tom Gill, deals primarily with policy and is in effect a revision of Forestry Series No. 2, now made possible by new basic data. Part II outlines a broad program of forest management, and is the work of H. D. Cochran and E. L. Demmon.

The report recognizes the many economic and social changes that have taken

place in recent years and the new facts developed in the Forest Survey and published as JCRR Forestry Series No. 3, "Forest Resources of Taiwan", and attempts to bring together recommendations for a long-range development program based upon these facts. It is sincerely hoped that this proposed program will be helpful to the whole field of forestry in free China, the recommendations be adopted and put into effect by the government for the sake of all those who are benefited by the forests of Taiwan.

Acknowledgments

The recommendations in this report were formulated after a study of available data on conditions in Taiwan together with observations on the ground, and following a number of meetings with representatives of the Taiwan Forest Products Administration (referred to throughout this report as Taiwan Forest Administration or TFA) of the Provincial Department of Agriculture and Forestry, the National Taiwan University, the Taiwan Forest Research Institute, and the Taiwan Provincial Government, and after consultation with officials of JCRR.

The authors wish to state without the generous cooperation of many agencies and individuals in Taiwan it would not have been possible to appraise so complex a field. Much of the groundwork for a forestry program had already been laid by the Forestry Division of JCRR under the supervision of Paul Zehngraft since its initiation in 1951.

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Summary of Recommended Measures

The goal of all forestry is to secure from the forests the highest permanent human benefits in terms of watershed protection and timber production.

To this end the recommendations that follow are made with one basic purpose: that the forests and forest soils of Taiwan be managed in the spirit of Dr. Sun Yat-sen's words, "The natural resources are the property of all the people".

It may be well to point out that the greater part of these recommendations requires no heavy expenditure for their implementation. They call, instead, for a better administrative set-up, for simplified procedures, and for the abolition of practices that impede sound forest management and, in extreme cases, threaten forest survival.

National Forest Policy

1. Fundamental concepts:

- a. Regardless of ownership, public interest to be paramount where the chief forest value is protection. Here some type of forest cover must at all times be preserved.
- b. Production forests to be managed as a perpetually renewable resource on the basis of sustained yield.
- c. Government to retain title to all its national forest land.
- d. Government to acquire any additional forest land necessary for protection.

2. Legislation (including regulations)

- a. Unless reserved for special purposes, all government-owned forest land to be administered solely by the Forestry Bureau.
- b. Present practice of leasing forest land for agriculture to be discontinued.
- c. Police power over forest violations to be vested in senior forestry officials.
- d. Present law to be reviewed with a view to determining other desirable changes.

3. Administration

- a. TFA to be reorganized.
- b. Private logging to be increased, particularly in hardwood stands.
- c. Volume limits to be abolished in timber sales.

- d. Allocation system of log and timber sales to be discontinued except for very limited government purposes.
- e. Timber sale procedures to be simplified; stumpage sales to be made only on bids.
- f. Cutting to be accelerated in conifers, greatly increased in hardwoods; utilization to be improved.
- g. Extension and Information Service to be created under TFA.
- h. Technical personnel to be used more effectively.

4. Reforestation

- a. All denuded and idle protection forest land to be immediately reforested.
- b. Rate of tree planting to be increased on understocked and idle forest land through land-lease or cooperative reforestation.

5. Erosion control

- a. Shifting cultivation to be minimized through extension and other methods.
- b. Protection forest lands to be reclaimed from illegal cultivation.

6. Protection of water supplies

All agencies to participate in coordinated land use programs for important watersheds.

7. Land classification

- a. Intensive ground survey to be completed for location and classification of agricultural, pasture, and forest land.
- b. Denuded National Forest land to be surveyed by PDAF to determine areas suitable for pastoral or agricultural use.
- c. Protection forests to be surveyed to determine actual needs and possible release for agriculture or for timber production.

8. Management of undetermined (non-reserved) forest land

- a. Definite boundaries to be established between undetermined forest land and National Forests.
- b. Undetermined forest land to be assigned to Hsien government for classification and management, except protection forest.
- c. All agricultural areas to be sold or leased.
- d. All non-agricultural areas to be reforested by Hsien, under management plan approved by TFA and under TFA supervision.

Forest Management

1. The national forest law should be amended to meet conditions on Taiwan.
2. Provincial forestry regulations should be consolidated and simplified.
3. Jurisdiction over all national lands should be redetermined.
4. Status of protection forests and their management should be clarified.
5. Land classification should be completed and made mandatory.
6. Boundaries of all public forest lands should be mapped and marked on the ground as soon as possible.
7. Taiwan Forest Administration should be reorganized to:
 - a. Give it bureau status at the highest possible level.
 - b. Coordinate (1) national forest management, (2) research, and (3) extension and education activities.
 - c. Improve and simplify timber sale procedures.
 - d. Separate logging and milling operations from forest management.
 - e. Gradually turn over logging and milling to private operation, including Ta Shu Shan.
 - f. Improve methods of preparing and using management plans on national forest.
 - g. Delegate administrative authority by decentralization.
 - h. Improve administrative procedures by curtailing paper work and cutting red tape.
 - i. Improve personnel efficiency, use technicians to better advantage, reward outstanding suggestions for work betterment, etc.
 - j. Delegate police power to top forest officers in the field.
8. Construction of forest roads into inaccessible areas should be promoted.
9. Leasing of public forest lands for agriculture should be discontinued.
10. "Undetermined forest lands" should be turned over to Hsiens and local governments for management.
11. Land lease to promote reforestation should be expanded.
12. Forest production and productivity should be increased by:
 - a. Increasing the cut in old-growth coniferous forests, now largely inaccessible.
 - b. Cutting heavily in hardwood stands and use part of income for reforestation, with conifers or valuable hardwoods.
 - c. Planting all available denuded or understocked forest land in next 30 years and provide for this in regular budget and cooperative funds.
 - d. Improving protection of forest from fire, insects and disease, and theft.

13. Forest utilization practices in the woods should be improved; high quality material, such as *Chamaecyparis* spp.; *Cunninghamia Konishii*, *Libocedrus*, etc., should be used only where high quality is essential; low quality wood where it will serve the purpose; more treated timber to be used.
14. Simplification of government measures is needed for:
 - a. Log and lumber standards.
 - b. Tax collection on forest products.
15. A large increase in exports of forest products in excess of domestic needs should be a future aim.
16. Private forestry should be encouraged, including (1) more private logging on public forests, (2) more private sawmilling, and (3) more preservative treatment of forest products to improve use and extend life as a means of better supplying the demand for forest products.
17. Prices for forest products should be simplified by eliminating the "preferred" price, curtailing the use of the "official" price, and gradually increasing dependence on market prices.
18. Allocation or sale of forest products by TFA to other government agencies should be strictly on basis of use intended.
19. Public education and extension in forestry including logging should be expanded.
20. Recreational use of national forests should be encouraged.
21. An expanded program of forest research should be encouraged.
22. JCRR forestry program should be continued but gradually turned over to TFA and local governments.

Part I: Policy And Legislation

By Tom Gill

Dr. Sun Yat-sen held that a country's natural resources were the property of the people and should be made to yield their highest good to the greatest number. It is in that spirit and toward that goal the great forest resource of Taiwan should be managed in perpetuity.

More than half of the land surface of the Island of Taiwan is better suited for tree growth than for any other purpose. The proper maintenance and effective use of so large a proportion of her land area cannot fail to have a dominant influence upon her national economy.

The daily life of the Taiwan people is intimately dependent upon wood, and in a very real sense their economy has been largely built upon wood. Taiwan needs wood for fuel and for her mines; she needs wood to equip her communication and transportation systems, and to supply pulp for her books and paper; she needs lumber for building construction and maintenance, and huge quantities of wood for the military.

The abnormally high prices for forest products are in great part a reflection of her intense and only partially satisfied wood requirements, and the increase of over four millions in her population since 1945 has raised Taiwan's wood needs to a point that is literally critical. Even during the Japanese occupation, large quantities of wood had to be imported, but today, both because of the increased population and a result of insufficient forest care in wartime, Taiwan finds herself under the necessity of importing wood for domestic needs.

But the need for wood alone fails to tell the full story of Taiwan's dependence upon her forests. Rugged topography, highly erosive soils, and a typhoon climate demand a forest cover to protect her precious agricultural lands, reduce the flood damage of her short, steep rivers, retard the siltation of her reservoirs, and give greater permanence to hydroelectric development.

Forest values in Taiwan are not to be measured only in terms of timber, fuel, and other products, important as these may be, but primarily in terms of preservation of soil and water, for the perpetuation of her forests is inescapably linked not only with the maintenance of her living standards but with her very economic existence.

During the past five years Taiwan has made significant progress toward a forestry program. Many thousands of hectares are now replanted, an excellent

land classification program is under way, and the most complete land use forest resource survey in any nation in the world has been completed. In addition, a number of practices detrimental to sound forest administration have been corrected.

In spite of all this, forest destruction goes on apace. Each year the area of denuded land increases, erosion damage is widespread, costly hydroelectric installations are endangered by siltation and by failing water storage, agricultural land is being obliterated by floods, while destructive agricultural practices and the use of fire steadily degrade the forest soils.

Yet Taiwan, thanks to a number of fortunate circumstances, should benefit promptly and abundantly from a further expanded and coordinated national forestry program based on facts now available. Taiwan has had long experience in reforestation and in forest management. Her climate is favorable to tree growth. She has fast-growing valuable species. High prices for forest products insure profitable returns. Because of transportation and other facilities already completed, future timber crops will be much cheaper to grow and to harvest. The ready availability of wood supplies made possible through increased forest development should be of no little importance from a military standpoint.

Meanwhile, Taiwan is making every effort to increase her agricultural crops by planning additional irrigation and hydroelectric development. But no agricultural program, no irrigation project or power development can afford to neglect the maintenance of the forest cover, for forests themselves are the staunch protectors of agriculture and the great storage areas of rainfall.

The very basis of soil survival and the control of erosion lies not in the paddy fields or the irrigation dams, but up on the hillsides where forests can best combat the destructive forces of wind, erosion, and flood.

Forest management should be an integral part of every conservation measure, whether it be soil protection, irrigation, or water storage, for until the forest soils are stabilized through tree growth, there can be no security for the agricultural lands below them, and expensive installations for hydroelectric development will remain in constant danger.

Uncoordinated or vacillating measures are costly and ineffective. Time, too, is an important factor. Each year's delay adds to the destruction by erosion, increases the costs of reforestation, causes loss of growth, and makes success more difficult and remote. Delay, then, in itself becomes a kind of failure.

On the other hand, a sound forestry program well conceived and vigorously

prosecuted should ultimately release Taiwan from her present dependence on costly wood imports and even bring her the benefits of export trade. A forestry program will help preserve her agricultural soils, protect her storage dams and hydroelectric installations from excessive siltation, and give far greater permanence to her systems of irrigation. A sound forestry program will also provide valuable training and experience for foresters whose skill and knowledge will be sorely needed upon return to the mainland.

Major Forest Values

1. Protection Forests

All forests serve in various degree to stabilize the soil against the forces of erosion, but the term "protection forest" is used to designate those forest areas whose chief function lies not in wood production but in holding the soils on critical watersheds and in retarding the surface flow of water through the maintenance of tree cover and forest litter. Additional protection values provided by this type of forest include the fixation of sand dunes and the beneficial effects of trees as windbreaks. They serve too a number of public purposes, such as the maintenance of scenic and recreational areas and of habitat for wildlife.

But the chief value of Taiwan's protection forest lies in their service to agriculture. If agriculture is to prosper, there must be a balance between land for crops and land for forests. Where no such balance exists, where massed concentration of an agricultural population—as in parts of mainland China—has resulted in the disappearance of accessible forests, wood for fuel and for farm and home use is no longer available, and the degradation of the soil has brought about erosion on a spectacular scale, with rapid runoff of surface waters and destructive floods.

In the more mountainous section of those older regions in China and the Near and Middle East, ancient civilizations have modified the vegetative cover, causing widespread damage to the soil itself. Within a few decades, regions once well forested are transformed into barren, dustswept wastes. Thousands of square miles of rich farmlands have been ruined and cut to pieces by gullies following the loss of forests.

Taiwan's steep topography, heavy rainfall, and unstable soils all conspire to make her particularly vulnerable to these destructive processes.

Forests whose values lie primarily in soil protection usually occupy the steeper slopes and upper watersheds, where soils are thin, tree growth slow, and a forest

cover once lost is difficult to restore. Because of their own vulnerability as well as because of the critical public need for protection forests, prohibition of all forms of economic use regardless of ownership is sometimes necessary. This may impose hardship upon owners and residents, and should be compensated for by subsidies or outright purchase. However, the policy should be clear that the public good is not to be impaired, and that private rights must be subservient to the general welfare.

Some nations have found that administration of critical areas in protection forests is most effective when private property rights are eliminated by outright government purchase. This is a long-term goal, but where necessary its eventual attainment should be made part of basic policy.

The amount of forest needed by a nation for protection purposes can be determined only by examination of the watersheds themselves and by actual results of management. In Taiwan the national forests already cover much of the area needed for protection, but forest policy should provide through legislation for the inclusion of whatever additional areas may be needed for this purpose, as well as for the elimination of areas not needed for protection purposes. A reclassification of Taiwan's protection forests should provide the necessary information.

Although the chief value of protection forests lies in their stabilization of soil and storage of water, they may also be improved by proper management and made to yield valuable forest products. But cutting in these forests should be very carefully performed under the closest administrative supervision and control. Protection forests are the bulwarks against the greatest enemy of agriculture and water power, i.e., erosion. This function should never be jeopardized.

2. Production Forests

To this great class of forests belongs all the timberland whose chief function is to provide wood for a nation. It comprises 81 percent of Taiwan's total forested area, or 45 percent of the Island's total land surface.

In the more accessible areas where human impact is heavy, these production forests have suffered enormous damage from over-cutting and abuse. In the hardwood forests, especially at the lower elevations, the removal of the more valuable species has degraded the composition by increasing the proportion of inferior woods. The forests have deteriorated to the point where not only their productivity is seriously impaired but the soil itself becomes increasingly sterile, and forest regeneration will be costly and difficult.

The bulk of the more valuable timber species—chiefly conifers—lies along the upper slopes of the mountains. Much of this forest is overmature, and when harvested will require reforestation and adequate fire protection in order to establish a new forest and maintain productivity.

The ultimate goal of management in Taiwan's production forests must be to develop fully stocked, growing forests, and then to balance cut with growth, i.e., to limit the amount of wood removed annually to the amount replaced by annual growth. This is the principle of sustained yield, the ideal for sound forest management throughout the world.

Taiwan's ever-increasing population and mounting demand for wood will call for the highest attainable growth rate, and under proper forest management the yield of products from her timberlands can be increased many times both in quantity and quality. Today their average yield is only a small fraction of their capacity. Growth in the high coniferous forests is more than offset by decay, and a great part of the lowland hardwood forests has been reduced to scrubby woodland producing little of value but fuelwood. Meanwhile, the nation is suffering a serious shortage of timber products and prices are exorbitant. In addition, there are ever-increasing areas denuded of forest growth—idle lands which give rise only to erosion, agricultural damage, and siltation, and make no contribution to the national economy.

These enormous areas of idle forest land provide a key to Taiwan's future welfare and employment. But the time to implement a forestry program is now, for in Taiwan the heightened rhythm of industrialization and the increasing population, together with the needs of the military, are creating vast new pressures for further forest exploitation. This human impact upon soils and watersheds, unless controlled, cannot escape being disastrous.

On the other hand, a forestry program boldly conceived as to policy, well implemented by legislation, and translated into action by an efficient administration can restore both the protection and production forests to full usefulness and enable them to provide the unique values that forests alone can contribute to Taiwan's economy.

National Forest Policy

1. Principles of a Forestry Program

In simplest terms, national forest policy should be directed to the restoration, protection, and perpetual maintenance of Taiwan's forests and forest soils in a condition of highest human usefulness. Policy should hold that since a continuous

flow of wood products is essential to the national economy, public necessity demands that the productivity of forest soils be raised to the maximum and so maintained.

Such a policy can be made effective only by means of a coordinated program for the development of Taiwan's forest soils wherever they are and under whatever ownership.

The program should be directed toward a dual goal. In dealing with the areas whose chief function is protection, policy should hold that regardless of ownership the public interest in soil and water conservation is paramount, and a forest cover must be preserved. In dealing with those forests whose chief function is production, policy should hold that they be managed as a perpetually renewable resource.

In administering these two great classes of forests, then, management should be directed toward the higher use, whether it be protection or production. Thus, in addition to assuring a continued and increasing flow of forest products, the objective of policy should be to combat soil erosion, reclaim idle lands, improve water storage, and influence water control.

Supplementary measures leading to the elimination of wood waste will play a contributory part in the forestry program, but in dealing with a source of raw material as basic as wood, Taiwan's fundamental means of assuring abundant and continuous supplies lies in a policy of protecting and improving the resource itself. It lies in a national policy of forest management, leading ultimately to the full use of all her forests in terms of both protection and production.

In order to lower timber prices, two specific measures should be included in a forest program: (1) a huge increase in the cutting and utilization of hardwoods, followed by planting of more valuable or more rapidly growing species, and (2) a gradual transfer of all logging activities to private operators.

Other administrative measures would be of immediate advantage to the Government and the private logger, and ultimately to the consumer. For example, the purchaser of government timber should be relieved of the necessity of paying the total price for the sale in advance. Almost all countries in the world require only a portion of the total purchase price to be paid in advance, with further advance payments called for as cutting progresses. This relieves the purchaser from making large-sum payments and from incurring burdensome interest charges which must ultimately result in higher lumber prices. A partial payment plan should be reflected in lower prices and a more rapid flow of forest products to a wood-hungry nation.

Similarly, preservative treatment of Taiwan's hardwoods would greatly increase their length of life and enable them to supplant conifers for many purposes. Taiwan has two excellent treating plants whose facilities should be more fully utilized, for to double or treble the effective life span of a railroad tie or construction timber is just as truly a conservation measure as doubling a tree's growth rate.

2. Legislation

The function of forest legislation is to implement forest policy.

Legislation makes possible the application of a forestry program and provides for the protection of forest values. Forest laws and regulations compose the rules for assuring the most favorable conditions for competent forest administration while at the same time imposing certain restrictions designed to protect and improve the resource. Forest law assigns the administrative and police duties necessary to adapt forest policy to a nation's special conditions and to insure its full application. Basic law lays down the broad lines of action, leaving the details to be dealt with in the form of regulations or ordinances.

Vigorous governmental leadership has always been necessary to insure adequate forestry measures. For forestry to be effective, it must be directed toward serving the broad national good. To this end, it is in most cases best administered by the Provincial Government itself, and not delegated to local bodies.

All legislation assumes the existence of a body empowered to insure its enforcement. The present Taiwan forest law, for example, implies a policy of strict regulation and control. But actual enforcement of many of its provisions has not been well implemented.

It is a dangerous practice for government to pass laws but fail to enforce them. Government should be prepared to support its forest laws vigorously and in their entirety; otherwise, it is far better not to enact them. Laws that are unworkable or unenforced either because the will is lacking or because police powers are not provided, breed contempt not only for forest law but for all forms of legislation.

Taiwan seems to have been delinquent in enforcing many of its forest regulations. Management plans are openly disregarded, petty timber theft is not uncommon, and the illegal use of public forest land for agriculture is widespread. Unless this can be corrected, there is little purpose in enacting further legislation and little hope for a successful forestry program.

Practically all nations having forestry programs invest their permanent senior

employees with police power to deal with violations of forest regulations. Such a provision in Taiwan should result in fewer violations. Enforcement should also be more effective if penalties for forest violations were made more specific and more in keeping with the seriousness of the offense.

The present Taiwan law is the older forest law of China, and certain provisions do not apply. Other provisions need amending or strengthening, and with the adoption of a national policy for an adequate forestry program further changes will be needed. For example, areas designated by the present law as protection forests should include all watersheds important to power development, water supplies, and irrigation projects.

3. Administration

A trained and well-organized administrative staff is the most effective and economic means of translating law into action. Much of the management of forest land involving high values is of a technical nature that demands personnel with specialized education and experience. Blunders in forest management cannot be erased in a day or a year, but take their toll in long-lasting financial loss.

A forestry program therefore should provide for an adequate organization competent to fulfill its professional obligations and endowed with the necessary authority. Satisfactory professional standards should be demanded as an essential to economic and efficient handling of the forests. It is equally important that tenure of office be secure so long as services are satisfactory, and that employees have freedom from political pressures in carrying out their tasks. It is no less important that employees be subject to recognized standards of effective performance.

The efficiency of Taiwan's forest administration could be greatly increased by the adoption of several measures. For example, it would be highly desirable to convert the logging stations to forest districts. It would also be desirable to relieve the Taiwan Forest Administration of its logging responsibilities, transferring them to a separate agency under the PDAF, and gradually turning them over to private concerns on a competitive basis.

The financing of the Forest Administration by an annual budget has been both logical and economical. It puts the responsibility upon the Administration to make an annual statement of its plans and needs. The budget, however, should bear no relation to income from timber sales, but should be based wholly on actual operational requirements. In forestry work, moreover, promptness in making

funds available is especially important. Delays, particularly in reforestation funds, may mean both a loss of time and of valuable planting materials.

The promotion of the Director of Forestry to Deputy Commissioner should bring about a very desirable integration between forest and agricultural activities. Since these two major classes of land use play coordinate roles and are frequently directed toward the same end, such integration should be mutually helpful.

The Forest Research Institute already operates an Information and Extension Section, but the Forest Administration itself is doing little of this type of work. This activity is so important it should be made a definite part of the work of both the Administration and the Forest Research Institute by creating a Forest Extension and Information Service and inaugurating a program of field contacts to be carried on by extension foresters.

Extension is a particularly rewarding activity, for when forestry measures are better understood and appreciated by the people—especially by the rural population—it is less difficult to secure cooperation and decrease forest violations.

Changes in public attitude toward the abuse of land and forests cannot be effected by legislation alone, and the ultimate goal of extension is to get conservation beliefs and practice incorporated into the thinking of the people. In many countries, extension and information activities have been so successful that forest legislation and policy are reinforced by the people rather than resisted.

The Taiwan Power Company has already obtained excellent results in fire prevention among the aborigines in the vicinity of Sun Moon Lake, and definite efforts in extension on the part of the Forest Administration should prove well worth the effort. Foresters of Japan have carried on intensive programs in extension work, and a study of their methods might be beneficial. The various materials and methods employed by the U. S. Forest Service could also be made available to the Forest Administration for possible use in Taiwan.

Forest extension is not costly, and it is capable of returning rich dividends in terms of cooperation, decreased violations, and support of forestry measures once the purpose and beneficial results are known.

A discussion of forest administration would be incomplete without a work concerning technical training. Competent administration depends upon a continuous supply of men trained to carry out their professional tasks, and fortunately Taiwan has several forestry schools to supply forestry technicians for the higher grades. Two of them grant bachelor degrees. A third, offering a 2-year course, requires completion of the middle school for entrance. Four others offer

3-year courses to junior school graduates.

The Taiwan Forest Administration also has an excellent training program for its younger employees, but many of the forestry school graduates find it difficult to secure forestry positions, and are forced into types of work where they are unable to make use of their training. In the interests of good administration, these men should replace as quickly as possible those with little or no technical training.

4. Reforestation

Taiwan has begun a vigorous reforestation program, the benefits of which are already being felt in terms of soil stabilization and food crop protection. It is desirable, in the interests both of economy and soil stabilization, to speed up the rate of tree planting, for in a well-planned, adequately financed program of reforestation lies Taiwan's greatest hope for a continuous supply of forest products and for the protection of her agricultural lands, irrigation systems, and water-power development. But the fact must be squarely faced that reforestation will involve the annual outlay of considerable sums over a span of many years. For best results, it must be started without delay, and must be expanded and continued without interruption. Postponement will only increase the cost and reduce the degree of success. On the other hand, returns from expenditures can be expected to begin in as short a time as ten years, with full harvest yields in thirty or forty years.

A further factor that will reduce costs and contribute to success lies in Taiwan's past experience in reforestation. Methods have been worked out, satisfactory species have been determined for different locations, nursery practice is well established, and the techniques of planting and transplanting are known.

But meanwhile denuded areas are contributing to Taiwan's economic difficulties by the steady degradation of her soils through the forces of wind and flood.

This area of denudation is a serious challenge to government. For here, if anywhere, lies the test of governmental intention either to treat the land as a perpetual asset capable of increasing values or as a mine to be exploited and abandoned. Taiwan, with its rapidly increasing population, cannot afford to leave a large part of its forest lands idle.

The goal of a reforestation program should be the progressive planting of all clearcut and denuded areas best suited for forest growth, as well as lands only partially stocked or covered with inferior species. Once this is accomplished, its function should be the prompt reforestation of all future cutover areas, wherever

artificial regeneration is necessary.

On commercial forest lands the most recently cutover areas should be reforested first as a method of reducing planting costs. Private capital and labor, through the use of land-lease and the other cooperative methods, should be employed fully in order to shorten the time factor, which always adds to the difficulty and expense of the task.

In fact, so great is the extent of denuded government forest land that it would be desirable to arrange with communities or private individuals to perform a large part of the actual planting under supervision of the Forest Administration. Such an arrangement under some form of lease or subsidy will reduce the initial costs of reforestation and should enlist the active interest of the local people in protecting the plantations. In the lowlands especially, the advantage of creating a situation in which villagers are partners in a reforestation enterprise cannot be over-estimated.

Land-lease reforestation presents an opportunity that should be further developed immediately, but whatever the terms of subsidy or length of lease, the title to the land itself should remain in the Government. Many countries in the past have allowed large areas of forest land to pass into private ownership. Much of this same land is now being bought back by government at great additional cost in order, at still greater cost, to repair the damage caused by misuse at the hands of private owners.

A reforestation program should give early consideration to those areas where erosion is most active and to those watersheds where hydroelectric development makes it imperative that the soils be held in place before further siltation endangers the installations.

It is literally true that the very heart of a forestry program for Taiway lies in reforestation. Neither policy nor legislation nor administration can bring about satisfactory forest conditions until the funds and authority are furnished to reclothe the denuded and wasting hectares of forest soil.

Once a reforestation program is completed, management should seek as far as possible to secure natural reproduction. Ultimately, artificial planting should be needed only for species that resist natural regeneration.

Meanwhile, better silvicultural practices will increase the yield and improve the quality of both conifers and hardwoods.

5. Erosion Control

Taiwan has some of the most highly erosive soils in the world. In attempt-

ing to deal with them, control measures have been confined largely to the lower slopes, yet it is well established that the place to attack erosion is at the top of the watersheds. In such areas, coordinated efforts by both the Forest Administration and other agencies will give the best results. An adequate system of protection forests and reforestation of the uplands, supported by soil conservation measures, are all necessary, but a unified program should be worked out jointly. In extreme cases it may be necessary to eliminate agriculture on certain areas and establish tree growth to hold the soil in place.

One widespread practice in Taiwan is causing enormous erosion damage. This is the practice known as "shifting agriculture", carried on both by the aborigines and by many Taiwan farmers, particularly on deforested areas and on the marginal lands of the foothills, regardless of ownership. It is the direct result of land hunger, and exists throughout the tropical world.

Shifting agriculture is most destructive when the farmer, driven by the need to find more cultivable land, pushes his agricultural patch out of the valleys and up the steep sides of the mountains where, without any measures to hold the soil in place, he grows his crops, often on slopes of over 100 per cent. He invades the high forests, where he fells and burns the trees on a hectare or two and, on the land thus liberated to sunlight and temporarily enriched by wood ash, plants his crop. For a few years this land may bear harvest, but soon erosion, soil exhaustion, or the invasion of weeds prevents further cultivation, so it is abandoned and another patch of forest burned. When pursued by thousands of farmers, this misuse of forest soil is capable of wrecking region after region. The process represents an enormous economic loss. The benefit to the farmer is scant, for his harvest pitifully small, but in his wake the widespread destruction of timber and soil is disastrous.

In dealing with shifting agriculture, it is impossible to lay down hard and fast rules. Making available agricultural areas, bench terracing, and absorbing a portion of the aborigines into industrial work should be of help. Elimination of "waste land" leasing for cultivation by the Hsien Land Offices, better law enforcement, and a vigorous extension program should go far toward preventing the destruction of new areas, and ultimately restore misused areas to forest.

The Forest Administration should place this problem high among its immediate duties, in order to decrease the areas of misuse. Where the danger is not so great, methods of soil conservation may be tried. But in most cases the effort should be to restore forests on such lands. Land leases for agriculture in critical areas should bear a clear stipulation as to how long they may be used, and should

contain provisions for reforestation under strict supervision with approved tree species at the end of the lease.

In areas of extreme erosive action or where high values of water and power supply are involved, the only safe solution is the ultimate elimination of cultivation. Wherever possible, other forms of livelihood should be substituted, such as the growing of fruit trees or tea under forest cover, or other agricultural pursuits that do not expose the bare soil to the action of sun, wind, and rain.

The solution of this problem of shifting agriculture will require skillful handling if strong opposition is to be avoided. Yet many countries have dealt with it, and their experience may prove of value to Taiwan.

6. Protection of Water Supplies

Protecting the sources of Taiwan's water supply is also a matter largely of reforestation and of preserving a forest cover. But so great is its importance to the nation's industrial development that it merits a separate statement.

Water should be looked upon as an indispensable natural resource whose conservation and wise use are particularly necessary in Taiwan. Water power is basic both to industry and to irrigation. Much money has already been spent in hydroelectric development, and further expenditures are planned. Power plants in the Sun Moon Lake area alone have cost almost US\$30 million, and more millions are being spent on new installations elsewhere. The utility of all these installations depends on storage water which may exist in many forms—lakes, reservoirs, springs, or marshes. The amount of water stored is governed largely by the vegetative cover which, holding back the runoff, allows the water to penetrate the soil. This ability to store water is one of the great functions of forests, and is the chief reason why deforested areas soon lose their power to retain the water that could later become available at lower elevations for agriculture and for power.

The water development projects of the Taiwan Provincial Government would be more reassuring were it not for the ever-present danger that these storage reservoirs will be rendered useless because of failure to control the flow of silt from the headwaters. No matter what the ultimate destiny of precipitation, its control depends largely upon vegetative cover, and neither irrigation projects nor storage dams can, by themselves, do much to correct silting and excessive runoff. That must be controlled in the uplands; it must be stopped at the source.

With each silt-laden flood, with each falling inch of water table, Taiwan loses agricultural production, potential power, and water supply.

A large part of the answer to all this lies in forest and soil protection, in the prevention of forest fires, and in the strict control of destructive forms of agriculture.

As an integral part of watershed development, forest management should precede all engineering installations in order to minimize siltation.

On important watersheds, as the Sun Moon Lake development, the Wu-sheh and Shih-men projects, reforestation should be prompt and complete. Such vital watersheds as these demand a coordinated land-use policy to minimize the damage that already threatens to reduce their usefulness. The power company has demonstrated a high degree of success in cooperating with the aborigines to secure almost complete fire protection. The Forest Administration should coordinate this with further measures leading to less destructive forms of cultivation than shifting agriculture. Allocation of areas suitable for permanent agriculture and diverting as many of the aborigines as possible to industrial pursuits may help toward a solution. But in critical areas, the goal should be the eventual elimination of all uses that cause erosion.

It would be a short-sighted and costly policy to continue the construction of hydroelectric installations without securing the full cooperation of the Forest Administration and all other interested governmental agencies in making a closely coordinated study of each proposed project with the purpose of adopting an integrated land-use program to minimize all the factors favoring erosion.

In dealing with such problems, untold damage may be avoided at very small expense. What is needed is recognition of the urgency for immediate land management in these watersheds and a prompt program of unified action. But it is scarcely likely that techniques of forest management and soil conservation will be applied on lands administered by non-forestry agencies.

7. Land Classification

To deal effectively with problems of the soil, it is necessary to know what is the highest human use for any particular area. To determine this is the purpose of land classification. It answers the question, "What should these hectares best be used for?"

A land classification program is now in progress in Taiwan in the form of a marginal land survey to determine what areas are best suited for agriculture, pasture, or forestry. This excellent program deserves and should receive continued support, and provision made to implement its recommendations for putting into actual practice the various types of land use.

In making a classification separating agricultural from forest land, there is no conflict between the respective needs of forestry and agriculture. Over many areas the chief value of forest land lies not in its ability to produce wood but in its protection to agricultural soil. Properly conceived, a forestry program is the greatest ally to agriculture and to power development in regions susceptible to erosion.

Taiwan needs every available hectare best suited for agriculture, and in any land classification program the effort should be made to classify all lands as agricultural which will permanently support food crops, provided such cultivation does not contribute to erosion damage.

Forest soils differ from agricultural soils in that their most valuable function is as producers of forest crops rather than food crops. Depending on their location, the characteristics that set them apart from farm lands may result from altitude, shallowness, steepness of slope, lack of fertility, or insufficient rainfall. But whatever the reasons, these are the lands which best contribute to the national economy by remaining under some type of forest cover.

With the knowledge of where the forest soils lie, and with the responsibility for administering them placed squarely upon the Forest Administration, another fundamental step will have been taken for putting a sound forestry program into effect.

But here it may be well to stress again that once an area in government ownership has been classified as true forest soil, its administration should remain within the jurisdiction of the Forest Administration. No possible objection can be made to the use of agricultural soil for agricultural purposes wherever such soils occur; but frequently the Land Offices have leased land that is clearly best suited for forests, and when used for agriculture can only contribute to the already widespread erosion damage in Taiwan. When the present land classification program has determined which areas are agricultural or pastoral and which are forest lands, those best suited for tree growth should be placed under permanent control of the Taiwan Forest Administration.

Forest management is a very long-time affair, and must have continuity of purpose, policy, and administration. It is manifestly impossible for the Forest Administration to carry out a program unless it has sole administrative power over the forest land for which it is responsible.

The division of authority between the Forest Administration and the Provincial and Hsien Land Offices is not only highly destructive of morale, but creates a reluctance to apply forest management.

To subject forest lands to lease by the Land Office is pernicious to administration and puts a premium upon forest destruction. The present practice of declaring an area "waste land" and leasing it as agricultural because the forest cover has been destroyed by fire or ax is prejudicial not only to the forestry program but to the conservation of the soil itself. This is the very land that needs prompt reforestation. It is very easy to create "waste land" by setting fire to the forest, but to assume that "waste land" and "agricultural land" are synonymous is a costly fallacy. The very basis for national forestry planning must lie in the authority of the Forest Administration to have sole jurisdiction over the forest soils of governmental lands.

Disputes over the correct classification of land will inevitably arise. Such disputes might well be reviewed by an advisory board, and final decision as to whether land is better fitted for forestry or for agriculture be made by the Commissioner of Agriculture and Forestry.

Land classification has the further advantage of furnishing data to enable the Department of Agriculture and Forestry to embark upon a program of integrated land use. Forestry and agriculture comprise Taiwan's chief methods for converting the earth's fertility into raw material, and best results come from coordinated programs to which foresters, agronomists, and soils experts contribute. Where, for example, as in the plateau above Taichung, highly erosive soils become unstable under cultivation, both agronomists and foresters should work together and lay plans either for less destructive methods of agriculture or for the ultimate conversion of much of the danger area into forests.

Definite boundaries should be established between the national forests and the so-called undetermined (non-reserved) forest lands. Except for the areas of protection forest, these undetermined lands should be assigned to the Hsien and municipal Governments for management. The Hsien and municipalities should classify these lands, and all areas suitable for agriculture should be leased or sold. Non-agricultural land should be leased for reforestation. The forest land should be managed by the Hsien according to management plans approved by the Taiwan Forest Administration and under the Administration's supervision.

In the interests of the national economy, the Forest Administration itself should take prompt steps to make available for agriculture every hectare within the national forests that can be cultivated without danger of erosion or soil deterioration. Equally in the interests of national economy, it should seek to restore to forest cover all national forest lands whose highest value, either for protection or production, clearly lies in growing trees.

The Taiwan Forest Administration should also examine its denuded lands

with the specific purpose of considering their possibilities for pasture as a higher use than for growing trees. The leasing of pasture land will both yield additional revenue to the Government and provide greater protein content in the national diet. The pasturage of livestock on national forest land should be administered by the Forest Administration in order to prevent soil deterioration and erosion through overgrazing.

In their protection forests, the Administration should carry out further classification work with a view to releasing agricultural areas or, where necessary, adding to the forest area. The coastal protection forests especially should be surveyed to eliminate all areas no longer serving protection purposes and, if need exists, establish new protection forests.

Conclusion

Taiwan today stands at the crossroads between forest restoration and forest destruction.

Thanks to many favorable factors, Taiwan can embark upon a program that will secure far greater watershed protection and wood production from her forest soils. The ultimate result of that program will be self-sufficiency in timber products, ties, and fuel, and an almost certain exportable surplus. Agriculture will enjoy the benefits of forest protection, and the life of the irrigation systems and hydroelectric installations will be vastly extended.

Beyond the scope of forest legislation but parallel with its purpose lies the ultimate goal of integrated land use. This is a concept that envisages each hectare as making its own unique contribution to the human good. It is an ideal of management based upon the results of land classification to determine what areas are best suited for agriculture, for forests, pasture, watershed protection, or for other use. In many instances, multiple uses of a single area are possible, but the governing factor must be to put the land to its highest use and so maintain it.

Forestry and agriculture are not competitive, but play complementary roles in land use as purposeful ways of dealing with the soil. Integrated land use through the unified management of all renewable resources should ultimately raise Taiwan's productivity to levels never before attained. It should decrease the need for both forest and agricultural subsidies, and effect enormous saving in expenditures for erosion and flood control. By working in cooperation with natural forces, and not against them, by using and not destroying the rich and varied gifts of the good

earth, Taiwan may enjoy a wealth of products from the soil now undreamed of. Certainly land management can never be effective unless it includes the great area of forest soils.

But if Taiwan continues to deplete her forests, permits her soil to flow down the hillsides, allows wind and sand dunes to obliterate her agricultural hectares, she, like many other nations, will find herself wood-hungry and land-hungry, faced with lowered living standards, water shortages, and power failure.

There is still time to rectify past mistakes. Through prompt and vigorous action, the people of Taiwan can avoid the long years of wood deficit that now face Japan, Korea, and other parts of Asia.

But half-hearted measures cannot restore a crippled resource. An inadequately financed, uncoordinated program, based on false economy, or the failure to adopt needed legislative or administrative measures will result in a waste of both money and effort.

Today, as never in the past, the world is watching Taiwan. Other nations will gain little confidence in the value of free enterprise if they must witness here how continued destructive exploitation makes human living more and more precarious. Confidence can be immeasurably strengthened if Taiwan is made a demonstration of the power that resides in wise land use to raise a nation's living standards.

The foresters of Taiwan, upon whom will fall the chief responsibility for the program's success, cannot but realize they are acting as guardians of one of their nation's richest assets. It should give them a deep professional satisfaction to know that under their guidance the forests of Taiwan can demonstrate the value of forestry both to the free world and to the watchers behind the Iron Curtain.

One thing is certain—each forward step toward forest restoration will enhance the national strength for peace or war.

Part II: Plan of Forest Management

By Cochran & Demmon

Introduction

Taiwan's forest resources constitute an important aspect of her economy, not only in protecting her watersheds but also in furnishing adequate supplies of forest products for her people. How well the forests serve these purposes will depend on the degree of management they receive. Numerous improvements in forest management practices are needed, as well as a sound policy, before forestry on this Island will be on a firm basis.

Taiwan's forest wealth was exploited under Japanese control (1895-1945), but a start was made on a forestry program during those days. For example, the national forests were established and partially divided into working circles and compartments, beginning in 1925.

Cutting of accessible timber was heavy during and immediately following world war II, and only in the last few years has the practice of forestry really advanced in Taiwan. However, there is much still to be accomplished before full use is made of Taiwan's forestry opportunities.

The current forestry program is largely in the hands of the Provincial Government, through its Taiwan Forest Administration, operating under the Provincial Department of Agriculture and Forestry. This organization has an excellent opportunity to develop Taiwan's forest resources for the benefit of all the people if it carries forward a constructive forest management policy.

Since 1951 when the Joint Commission on Rural Reconstruction set up a Forestry Division, a number of forward-looking forestry measures have been initiated throughout the Island. Studies have been made on the general forestry situation and many cooperative forestry projects have been carried out in cooperation with local government agencies. This entire program is designed to make possible the development of local forestry measures so that they will be continued on their own merits after the JCRR assistance is terminated. One of its outstanding accomplishments was the completion of a comprehensive forest and land-use survey in 1956, the results of which are now available in form of comprehensive maps and a printed report, "Forest Resources of Taiwan".

Upon completion of this forest and land-use survey, arrangements were made

to have the present team of U. S. foresters come to Taiwan to advise and assist the Chinese Government in developing a revised forest policy and in outlining a plan for forest management which would best fit the needs of the country. The present report summarizes the recommendations of this team. Its implementation rests upon the future actions of the Chinese Government and all agencies involved in forestry work throughout the Island. With the whole-hearted cooperation of all, forestry can play a major role in the future economy of Free China, and provide employment opportunities for many of its citizens.

Current Forest Conditions

As a result of the thorough survey of its forest resources conducted from 1954 to 1956, Taiwan now possesses as comprehensive and up-to-date an inventory of its forest resources as any country in the world. It is possibly the best survey of its kind yet made, as it is based on the most modern methods and techniques developed by the forest survey of the United States, initiated in 1930, and which has now covered about two-thirds of that country's forest lands. The basis for many of the recommendations contained in our present report are the findings of the Taiwan forest and land-use survey.

Forests have always covered a large part of Taiwan. 55 percent of its land area¹, or 1,969,500 hectares, is forested, although roughly two-thirds can be classed as forest land. Thousands of hectares of land formerly forested but now either denuded, in grass, or in dry farms are better suited for timber growth than for any other use. A portion of the forest (about 13 percent) consists of overmature virgin stands of high potential value, much of it inaccessible, located in the central mountainous areas.

Many of the more accessible forests have been cut over and are in need of reforestation if they are to again become fully productive. Due to past cutting practices, widespread clearing of forest land for temporary agricultural use, and lack of measures to obtain a new stand of trees after logging, about a million hectares of Taiwan's forest land are now idle or producing but a small fraction of its capabilities.

The predominant forest type on the 1,969,500 hectares of forested land in Taiwan consists of hardwoods (73%). Other types include conifers (19%), mixed hardwoods and conifers (2%), and bamboo (6%). Ninety percent of the hardwoods and bamboo are economically accessible, whereas only 30 percent of the coniferous forests are accessible at present.

¹/ Information covers only Taiwan proper, and does not include the outlying islands.

Of all its forested land, 1,409,000 hectares or 72 percent is in the established national forests and under management by the Taiwan Forest Administration, although a total of about 90 percent of such land is owned by the national government. The remainder is in other public ownership (Hsiens and municipalities) or privately owned. Therefore, future forestry progress in Taiwan is largely the responsibility of its governmental agencies.

Boundaries of national and public forests and reservations are not well marked on the ground, which leads to trespass and hinders good forest management. Well designated boundaries for all public forest land is one of the essentials of a sound forestry program.

For the most part, land best suited to agriculture has already been developed for that purpose and is in private ownership. Some land better suited to forests and mostly in public ownership, has been cleared for temporary crops of citronella, bananas, sweet potatoes, etc., and this has led to widespread soil erosion and deterioration. Much cut-over forest land now has but a scattering of forest trees, usually of little commercial value, and some forest areas have actually been denuded of all tree growth. This poses a huge task of reforestation if these areas are to serve useful purposes in the foreseeable future. During recent years a good start has been made on a reforestation program but a complete planting job will take many years and much effort on the part of all forestry agencies.

The Taiwan Forest Administration is responsible for the management of all national forest land. Most of this is in designated working circles and under the direct supervision of TFA personnel. Other parts of it however, are under the administration of other agencies, but subject to the approval of TFA as to plans of management and as to operations on the ground.

The Provincial Department of Civil Affairs is responsible for the aborigine reservations, which are made up predominantly of forest land. They comprise in all about 213,188 hectares. The same general type of management should be practiced in these reservations as in the "reserved" National Forest. Foresters should be employed to furnish advice and technical skill to this end.

There is a substantial area of land in the National Forest—140,822 ha. according to Taiwan Forest Administration official statistics—known as "undetermined" forest land. It was so classified by the Japanese during their occupation of Taiwan. Translation of the term into Chinese has taken the form of "unnecessary forest land" and has resulted in confusion as to what was intended by the original classification. It is located characteristically along the foothills where the rugged, forested mountains break into the agricultural valleys. The most com-

mon opinion is that the land involved was merely regarded as marginal, requiring further study before final classification could be made. Much of it appears to be forest land, according to a land classification survey now in progress under the sponsorship of JCRR, but agricultural land is interspersed to varying degrees.

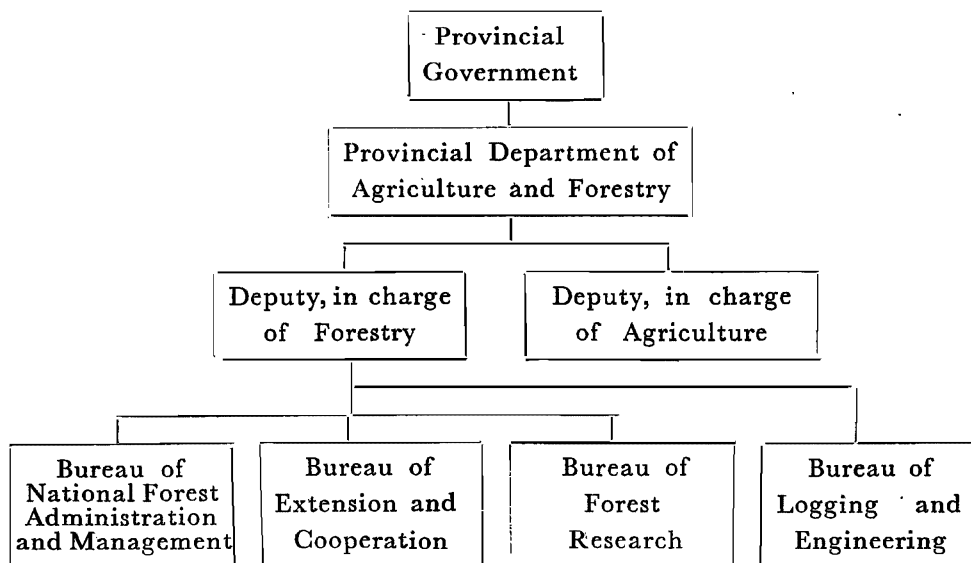
The type of forestry to be practiced on this land will be determined by the character, size, and distribution of the tracts and will in general differ from the practices required in the more continuous forests lying above them. The timber produced here will be used mainly to meet local needs, and operations ordinarily will be smaller than in the high mountains. For these reasons the job of managing them appears to be more suited to local units of government than to the Provincial Forest Administration. Local responsibility for forests of this character in other countries has fostered cooperation between local and central governments, stimulated popular support for a sound broad forest policy, and provided adequate and economical administration for public land of this character. It appears to be the appropriate method of management here. The Hsiens in which this land is located are now participating in the management of it, but a more complete and clear-cut delegation of authority is desirable.

There are other tracts of National Forest land variously under the administration of the Taiwan Forest Research Institute, the National Taiwan University, and land agencies of both the Provincial and the Hsien Governments. The desirability of having a clear definition of their responsibility and authority, and also of their relationships with each other and with Taiwan Forest Administration is obvious.

There are three areas designated as National Parks: Taten on Grass Mountain outside of Taipei, Mt. Ali and Mt. Hsinkao, and Toruko Gorge. The exact areas within these parks are not clear, nor is the provision by the Government for their supervision and management. This situation should be clarified.

In order to meet the demands placed on the provincial forest administration—at present Taiwan Forest Administration—by the recommendations of this report, the agency should be given top rank in the Department of Agriculture and Forestry. The director of such a unit should have full authority to correlate land use for forestry with land use for agriculture and administer pasture use of the national forest where such use is appropriate. He should be in a position to integrate national forest administration and research and to support both activities through an aggressive program of extension and cooperation. For all these purposes he should have the rank of Deputy Commissioner of the Provincial

Department of Agriculture and Forestry. In this position he could serve in relation to the rest of the Department as suggested in the following diagram.



Fortunately, Taiwan's soils and climate are generally conducive to rapid forest growth and development. Also, Taiwan is fortunate in having a great variety of valuable native forest tree species which, given proper care and management, can produce a wealth of forest products needed for the local economy and many suitable for export. The great range in climatic and topographic conditions in different parts of the Island has resulted in several major forest types and a great variation in growth rates for different tree species.

Much of Taiwan's forest is still inaccessible because of lack of roads or other transportation facilities. The Japanese constructed a number of logging railroads and cableways during their regime, but at present only two-thirds of the forested area and 52 percent of the total timber volume on the island is considered commercially accessible, i.e., with little additional expense for transportation facilities. This fact poses an urgent need of future road construction to open up the more remote areas for forest production. Such roads would also open the country for recreation and the wonderful scenic attractions now entirely locked up.

According to forest survey information, Taiwan's forests contain 186 million cubic meters of wood, of which 80 percent is in trees of sawtimber size (at least 30.0 c.m. in diameter at breast height, 1.36 meters above ground, outside bark). Currently 97 million cubic meters of this volume is considered accessible. On the accessible, commercial forest land, the more valuable conifers are being depleted by cutting and mortality and show a growth loss each year, whereas most of the

current growth is taking place on small hardwood trees, of relatively little value. What is needed is to get all forest areas, both hardwood and softwood, under good forest management and take advantage of the excellent growth possibilities. It has already been demonstrated that areas now confined to low-value hardwoods can be readily planted to and support the more valuable conifers.

Under good management it is conservatively estimated that the present 1.3 percent net annual growth rate of Taiwan's forests could be increased several times. The forest survey indicates that total net annual growth for the Island is 2,373,000 cu.m. (2,862,000 cu.m. on hardwoods and a loss of 489,000 cu.m. on conifers), while on the presently accessible forest areas the net growth is only 1,429,000 cu.m. of which practically all (1,425,000 cu.m.) is on hardwoods and only 4,000 cu.m. on conifers.

When one compares the current rate of growth with the current cutting or drain on the forest, the situation looks very favorable for increasing the cut. For example, total net annual growth on all growing stock at the time of the survey (1954-55) was 2,373,000 cu.m. with a comparable cut of 1,289,000 cu.m. (On presently accessible forest land the growth was 1,429,000 cu.m. compared to a cut of 1,275,000 cu.m.) This points to the need for opening up the inaccessible as rapidly as possible so as to harvest timber that otherwise is not available and therefore is being lost through mortality. This is contemplated in plans for new cross-island highways, one of which is currently under construction. Also, development of timber areas such as the new Ta Shu Shan logging unit, will increase the area of accessible forest land. Whether this can or should be done by public or private capital is an important question to be considered. Certainly much Taiwan timber is lost every year because of lack of accessibility.

This is illustrated by the following table, the data for which were furnished by the Forestry Division of JCRR. It shows a possible annual cut of 2,015,700 cu.m. and 2,010,300 cu.m. which could be harvested from accessible and inaccessible forest areas respectively. This presents the case conservatively, i.e. on the basis of a 40-year cutting period. In view of the heavy losses in the coniferous stands a shorter period (more rapid liquidation) would be preferable from the viewpoint of salvage, provided of course, that reforestation activities could be correspondingly increased and that sufficient young timber of suitable sizes would be available to sustain continuous logging operations.

Growing Stock, Net Annual Growth by Forest Type, and Cutting Plan

| Kind of forest land | Forest type | Growing ^{1/} stock (1000 cu.m.) | Net annual growth (1000 cu.m.) | Average ^{2/} Annual cut (1000 cu.m.) | % |
|------------------------------------------------------------|-------------|------------------------------------------------|--------------------------------------|-----------------------------------------------------|-----|
| | | | | | |
| 1. Commercial forest land (Accessible, unreserved) | Conifers | 24,011 | -2 | 449.5 | 22 |
| | Hardwoods | 59,388 | 1,207 | 1,566.2 | 78 |
| | Total | 83,399 | 1,205 | 2,015.7 | 100 |
| 2. Reserved forests (Accessible, protec- tion) | Conifers | 4,898 | 6 | | |
| | Hardwoods | 9,278 | 218 | | |
| | Total | 14,176 | 224 | | |
| 3. Inaccessible forest land (Including in- operable) | Conifers | 67,454 | -493 | 1,079.9 | 54 |
| | Hardwoods | 20,878 | 1,437 | 930.4 | 46 |
| | Total | 88,332 | 944 | 2,010.3 | 100 |

^{1/} Growing stock volume: Total tree volume to 8 cu.m. top.

^{2/} Average annual cut: $\left(\frac{\text{Growing stock volume}}{40} + \frac{\text{Net annual growth}}{2}\right) \times \text{Utilization rate (75\%)}$

Only the reserved National Forests are under formal management-plan operation. The preparation of such plans began in 1925 under Japanese occupation. The National Forests have been subdivided into 42 working circles ranging from about 8,000 to 96,000 hectares in area. These have further been subdivided into compartments. Superimposed on these national forest units are the so-called protection forest areas, covering 379,000 hectares where cutting is not allowed except under certain conditions; also, some of this protection area (76,400 hectares) is under cultivation or is non-forested.

The original national forest management plans have in large part been revised, but as a central office compilation job, and not closely related to actual conditions on the ground. As a result they fail to serve the purpose for which they are intended. Furthermore, the six Taiwan Forest Administration logging stations operate without complete adherence to management plans, although a comprehensive plan has recently been prepared for the new Ta Shu Shan logging area. It is advisable to construct immediately (1) an overall long range plan of management for Taiwan, based upon the recently completed forest survey, indicating annual allowable cut based on population increase, annual reforestation obligations, road development, etc. and (2) individual district and working circle management plans (10 years) based on additional field investigations. The latter

should provide for annual cutting budgets, reforestation measures (natural reproduction or planting), measures to assure protection from fire, insects and disease; also to assure road and transportation plans and cost budgets. Length of rotations and size of cutting budgets will vary for different growing conditions, markets for timber products, accessibility, etc. In general, relatively short rotations and frequent cuttings are feasible in Taiwan because of rapid growth rates and good markets for forest products.

Natural forest regeneration cannot be relied on to secure adequate restocking of cut-over old growth areas in Taiwan. With second-growth conifer stands it may be possible to secure natural reseeding, and on hardwood areas sprouting can often be expected. However, comprehensive studies of natural regeneration have not yet been made; this is an important problem for research.

Since most cut-over hardwood forest areas are not yet under management and are generally covered with only a partial stand of inferior trees, clear cutting and planting seems to offer the best possibility for getting them back into maximum production.

Between 1900 and 1941, 307,000 hectares were planted to forest trees in Taiwan. Following the war, the planting program picked up again and with the stimulation of JCRR, planting during the four years 1953 to 1956 averaged about 40,000 hectares per year. Acacia has accounted for about half of these plantings, followed by China fir (*Cunninghamia*), Japanese *Cryptomeria*, pines, and other tree species. In the meantime, new areas were logged off at the rate of about 13,500 hectares per year (1953-1956) and also need to be reforested to continue productive.

According to the recently completed forest resource survey, Taiwan has at least a million hectares of land now in grass, denuded, or poorly stocked, which must be planted to forest trees if it is to serve a useful purpose. The current 4 year economic development plan (for 1957 to 1960) calls for new forest planting at the average rate of about 44,000 hectares per year for this period. At this rate and the present rate of cutting it would take at least 30 years to complete the tree planting program on these areas.

In any reforestation program, care should be taken to select those tree species best suited to each planting site. Also, careful selection of seed from superior mother trees and the best seed sources is very important. Experience in other countries has shown the great advantage offered by careful selection of seed and the adoption of the principles of tree breeding and forest genetics to improve tree growth both as to volume and quality. Here is another project that requires the help of forest research.

Another important aspect of forestry in Taiwan is securing adequate protection of forests from fire, and harmful insects and diseases. Although fire has not burned over any great portion of the total forest area at any one time, much damage has been done in the aggregate by uncontrolled fires and those set for land clearing and hunting. Fire suppression is extremely difficult in much of the Island because of rough topography and inaccessibility. Improvements in fire fighting organization and in public educational activities for fire prevention, together with better law enforcement, will greatly benefit the entire forest management program. Furthermore, constant watch must be kept for injurious forest insects and diseases, and research should provide answers to problems of their control.

The demand for forest products in Taiwan has for many years exceeded local wood production, with the result that imports have been needed to make up the difference. The fact that market prices of local forest products have often exceeded those of similar imported products indicates that with all its forest resources, Taiwan must increase production and lower costs through more efficiency in growing, harvesting, manufacturing and selling its forest products.

In this study of forest management needs for Taiwan there is considerable evidence that research has not kept pace with the need for its services. This may be due to (1) lack of proper coordination between research and administration, (2) insufficient demand or lack of understanding of the need for an adequate research program, (3) insufficient finances to carry on such a program, or (4) a shortage of trained research personnel. At present forest research is being conducted by several agencies in Taiwan and their various programs are not very closely coordinated. Much of the current research was inherited from earlier programs under the Japanese.

The setting up of a forest research advisory council for the Forest Research Institute was a forward step and has undoubtedly led to an improved program. However, now that a new and comprehensive survey of Taiwan's forest resources is available it would seem advisable to take a new look at the forest research needs for the Island and to prepare a comprehensive forest problem analysis. This could then serve as a guide to assure that the research program is well oriented and aimed to meet the most important forest management problems as they arise. It is indispensable for a sound program of research.

Taiwan has the potential forest resources to meet its present and future needs if properly managed. Every possible measure should be taken to make this possible.

Forest Economic Situation

The forests of Taiwan enjoy almost ideal growing conditions. Subtropical temperatures combine with an abundance of moisture and natural soil fertility, and—except in the high mountains—there is no dormant season. As a result many species of trees thrive in Taiwan. Dense stands become established easily and grow rapidly. Large volumes of wood, often of very high quality can be produced in surprisingly short periods.

An example has been reported of a China fir (*Cunninghamia lanceolata*) plantation yielding NT\$10,000 per hectare ^{1/} from a light thinning 5 years after planting, the cost of which did not exceed NT\$2,000. This return is comparable in value to agricultural crops. It will continue annually and will increase rapidly with age. It requires less expenditure of money and labor and is better land management on marginal soil types. *Cunninghamia lanceolata* is an exotic species introduced from the mainland about 100 years ago. A local species (*Cunninghamia Konishii*) appearing in certain localities grows even faster.

Another exotic that finds itself at home in the hospitable environment of Taiwan is the Luchu pine, introduced from Okinawa about 50 years ago. According to the Taiwan Forest Research Institute ^{2/}, Luchu pines “have grown to 0.5-0.8 m. in breast-height diameter in 25-30 years..... moreover sometimes there are 45-year-old standing crops whose volume per ha. amounts to 850 m³.” According to “Forest Resources of Taiwan”, the forest survey recently issued by JCRR, “One 30 year old plantation has trees 30 inches d. b. h. and with good height and form”. Similar volumes are recorded for cryptomeria of the same age. ^{3/} There are few places in the world where natural conditions combine to make forestry so productive.

Results of the same order can be cited from plantings of *Acacia*, *Cassia*, *Melia*, *teak*, *Casuarina*, *slash pine*, and other species, both native and introduced. A few of these are shown in the accompanying tabulation compiled by Mr. Zehngraft of the JCRR Forestry Division.

^{1/} US\$160 per acre.

^{2/} “Studies on the Growth and the Management of the Standing Crops of Luchu Pines”, by Chi-wang Huang, 1951.

^{3/} “Yield Table of Japanese Cryptomeria in Taiwan”, by Shen-shiao Liu, Pao-lin Yang, Huan-yung Shu, Sung-fan Chen, TFRI, 1955.

| Agricultural Crops ^{1/} on Agricultural Lands | | Forest Crops on Forest Lands ^{2/} (Plantations) | | | | |
|-----------------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------|-------------------------------|------------------------------------------------------------------|-----------------------------------------|---------------------------------------------------------|
| Crop | Total ^{3/} Annual Income (NT\$/ha.) | Species | Harvest Cutting (years) | Commercial Volume(m ³) Harvested ^{4/} | Unit Price (NT\$/m ³) | Average ^{3/} Annual Income (NT\$/ha.) |
| Rice | 12,864 | Cunninghamia | 20 | 200 | 1,800 | 18,000 |
| Sweet potato | 11,505 | Cryptomeria | 25 | 240 | 1,800 | 17,240 |
| Pineapple | 9,324 | Pine | 20 | 200 | 936 | 9,360 |
| Jute | 8,787 | Camphor | 30 | 300 | 900 | 9,000 |
| Peanut | 6,230 | Acacia | 15 | 150 | 792 | 7,920 |
| Sugar cane | 5,085 | Teak | 25 | 180 | 1,050 | 7,560 |
| Cassava | 3,998 | Cassia | 15 | 120 | 540 | 4,320 |

^{1/} Agricultural data from Provincial Department of Agriculture and Forestry and Rural Economics Division, JCRR.

^{2/} From TFA. Unit prices: Market prices in December, 1956.

^{3/} All values include harvest costs, which for forest products average from 20% to 40%.

^{4/} Commercial volumes harvested are average net log volumes on medium sites.

The following explanatory notes should accompany the table:

"1. The extremely high incomes from forest crops are due to the present abnormally high prices of forest products. No doubt, as the recently established plantations, and those which are planned for the near future, begin to produce commercial products, the prices of wood products will gradually go down. Still, it is doubtful that they will ever go down to the point where forest lands will yield less than agricultural lands."

"2. The forest products, however, are grown on mountain lands with comparatively poor soils, and unsuitable in general for agriculture. If they are not yielding forest products, they would therefore yield nothing and would constitute a hazard to agricultural production in the form of erosion, water shortages, etc."

"3 Forest yields result from but one planting followed by two years of tending after which nature does the rest until harvest time."

Conditions generally are very favorable for maintaining a high level of timber production in Taiwan.

There are two basic requirements to be met however, if this level is to be maintained. They can be explained in terms of capital and interest. The forest capital is made up of the growing stock, i.e. the living trees. The interest is accumulated in the form of annual wood increment resulting from the growth

of the trees. In Taiwan this can be as much as 5—6 percent per annum in volume and more than that in value, but in natural stands at present it is much less. Thrifty, fast-growing trees and well stocked stands are the two requirements that must be met for full production.

The first requirement—fast-growing trees—is lacking in the over-aged coniferous stands of the high mountains. Trees are hundreds of years old and growth is stagnant. Mortality among these old trees removes more volume each year than is replaced by growth. Yet the quality of the timber is high. Taiwan cypress (*Chamaecyparis* spp.) found in these stands ranks among the most valuable species in the world with respect to the technical qualities of its wood—straight-grained, light, strong, durable. Other species, though of lesser value, are still outstanding because of the large size and slow even growth of the overmature trees.

Some of these stands are classed by the JCRR forest and land use survey as inaccessible—"Forest land where logging and hauling could not be done profitably in the foreseeable future." On this basis only about one half of Taiwan's total timber volume would be operable in the foreseeable future. The definition given for *accessible forest* land is more encouraging—"Forest land where logging and hauling could be done profitably with *little additional investment* in roads, railroads, or logging and transportation equipment."¹ Fortunately the high-quality product of the inaccessible forests is one that will bear high processing costs and still show a margin for profit. The same quality will enable it to compete successfully on an international market.

The Province of Taiwan and the National Government of Free China can ill afford to forego the benefits to be derived from liquidating these values and converting these stands into fully productive growing forests. The control of these forests is in the hands of the Government and can be directed effectively by it. Steps have been taken to develop a trial project for the harvesting of the timber in the Ta Shu Shan logging unit, parts of which were formerly regarded as a part of the "inaccessible" area. This is a progressive move and commendable. The project is well conceived and is organized along practical lines. It should be pushed to completion and followed aggressively with other measures to more fully realize the potential value of this latent resource and serve as a demonstration for other management units.

The total annual loss from mortality in coniferous forests of the higher elevations is 1,455,000 cu.m., as determined in 1954. Of this loss 1,323,000 cu.m. is saw-

¹/ "Forest Resources of Taiwan", Forestry Series No. 3, Chinese-American Joint Commission on Rural Reconstruction.

timber. This appalling loss in overmature coniferous timber is substantially higher than the total annual cut of 1,289,000 cu.m. from all the forests in Taiwan^{1/}. The reason that this timber is not being harvested is that the areas are not yet accessible.

This situation directs attention to the importance of studying the problem of accessibility more thoroughly and of determining which of these presently inaccessible stands can be made accessible. The criterion of accessibility should be based on the economic values to be realized. This is important, not only as a means of capturing such values, now being lost, but also as a means of relieving pressure on accessible areas where cutting at present actually exceeds growth.

Problems of accessibility in the high mountains can not be dismissed lightly. Neither should the high value of the timber at stake be ignored. The solution is to be found in balancing costs and benefits. This can not be done satisfactorily on a piecemeal basis, but calls for a comprehensive, systematic study of transportation development for the whole forest area of the Island. It is a prerequisite to sound timber management planning, and should be done before the accessible stands are overcut to the extent that a future production vacuum will occur.

Much of the current loss from overmaturity occurs on protection forests where no cutting, even for the salvage of this class of timber, is now authorized. One of the recommendations of this report is that the present areas and the regulations for their administration be studied with a view to making desirable adjustments and revisions.

Sustained yield is a fundamental principle of forest management, i.e., balancing growth and drain. It manifestly is applicable, however, only to a growing forest. To limit cutting in an overmature forest to annual volume increment is to abandon a substantial volume to loss by natural, designated collectively as mortality. This volume should be harvested instead by industrial operations, which means the annual cut could well—economically should—be equal at least to the gross annual increment and taken roughly to the extent of 50 percent or more from overmature stands. But this is not enough. This overmature timber has suffered, to varying degrees, the ravages of deterioration through decay and other natural causes. Limiting an expanded cut to the equivalent of current mortality would be analogous to eating only the rotting apples out of a barrel. Far better to remove the source of defective products (overmature stands) and build a policy and plan of forest management based on a thrifty, growing forest capital. The

^{1/} "Forest Resources of Taiwan", Forestry Series No. 3, Chinese-American Joint Commission on Rural Reconstruction.

soundness of such a procedure is enhanced by the ease with which new forests can be established in Taiwan and the rapidity with which they grow into commercial production.

This indicates that the coniferous timber, in which the overmature stands occur, should be cut over as rapidly and as heavily as is needed to remove stagnant forest capital. The cut should be limited only by markets that will absorb the product and make operations profitable. If domestic requirements do not seem to offer an outlet for a substantial increase in production, foreign markets might, and in so doing help to increase Free China's balance in foreign trade, which is a recognized economic need. Replanting should be done currently and special treatment accorded where appropriate, to protection forest areas.

The low-altitude, accessible (mostly hardwood) forests are an example of failure to meet the second requirement for full production—well stocked stands. Because of their accessibility, in contrast to the coniferous forests of the mountains, they have been heavily cut over. As a result the land is denuded or, worse yet, is encumbered with a scattering of cull trees. In too many instances efforts have been made to convert the land to agricultural use. The soil often is thin and because of steep slopes it deteriorates rapidly under cultivation as a result of erosion. The net result is idle land or under-stocked, inferior, forests.

Fortunately many valuable species have been tested and found well suited for reforestation there. An active program is in effect through cooperation between many agencies and groups for growing the nursery stock and planting it out on the land. This is one of the most commendable efforts in the whole field of conservation and land use in Taiwan. It reflects great credit on JCRR, many agencies and levels of government, and a cooperative public. The program offers the greatest immediate opportunity of improving forestry especially in relation to agriculture and other land uses, and should be pushed to completion accordingly.

Three and one-half million hectares of land, much of it too high and too rugged for human habitation, support a population of 10,000,000 people on the Island of Taiwan. Each person shares one hectare with two others. He has the equivalent of a little less than 0.9 of an acre to move around in without bumping his next neighbor. His counterpart in the U.S. has 12 acres as his pro rata share. Taiwan, furthermore, enjoys the distinction of having one the highest birth rates of the world, resulting in an annual population increase of about 3 percent ¹/. At this rate the Taiwanese's present quota of less than 0.9 acre will

¹/ According to Rural Health Division, Joint Commission on Rural Reconstruction.

shrink to less than 0.7 acre in 10 years. The sea about and the air above offer his only frontiers. Population pressures are intensified by the fact that Taiwan is living in a state of emergency, supporting a military establishment amounting to about 6 percent of its total population, not including families.

The dense population of Taiwan, which places a heavy, and growing, demand on its forest resources, also—by way of partial compensation—provides an abundance of labor. This population is predominantly agricultural and, pending further industrialization on the Island, is in need of employment in hand labor. By the same token, wages are low and should permit carrying on both logging and reforestation at reasonable costs where a large proportion of the labor required is unskilled and can be fitted into the seasonal requirements of farming.

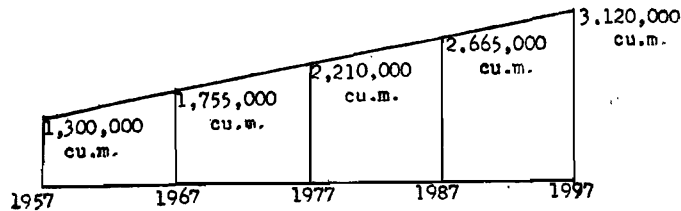
The exceptionally high value of the cypress forests has been mentioned. It is by no means an isolated instance. Other timber types have lesser though substantial values. Practically all of them, except hemlock and spruce-fir, are more accessible, which obviously results in a relatively higher net commodity value. They offer a wide range of products in the form of lumber, structural timber, craft specialties, pulpwood, synthetic board, matches, charcoal, fuel, derived products (chemical, including a number of drugs) and fruit. In one or two instances not only wood, but also bark and leaves of the same tree all have commercial value. Most of these products offer opportunities for expanding industrial activities, and this is an outstanding need in raising the standard of living for a dense population that is day by day becoming more crowded.

The domestic requirements of Taiwan for wood for the immediate future have been estimated variously from 1,300,000 cu.m. to 1,930,000 cu.m. per annum, including 550,000 cu.m. of fuelwood supplied from forest growing stock, in addition to 2,281,000 cu.m. of wood fuel from non-growing stock. These requirements are an essential part of the economy of an active, expanding population. The present timber requirements from forest growing stock are not inconsistent with present production from Taiwan's forest, estimated at 1,289,000 cu.m. plus net imports of 59,749 cu.m. ¹/. Under proper management the forests can supply a much greater demand.

And a much greater demand is sure to develop. Population growth alone should cause a substantial increase. For the purpose of a rough approximation, it may conservatively be assumed that the population will be 2.4 times as great in 40 years as it is today—based on 3.5 percent (simple interest) per annum. It

¹/ "Forest Resources of Taiwan", Forestry Series No. 3, Chinese-American Joint Commission on Rural Reconstruction.

may also safely be assumed that in consideration of prospective industrial developments and increases in living standards, timber demands will increase in direct ratio. If, therefore, the present demand is 1,300,000 cu. m. of timber per annum, the demand 40 years from now should be 3,120,000 cu. m. per annum. This coincides very closely with the potential annual cut from Taiwan's forests as computed on the previous Table (p 29). It is shown in the following graph suggested by Paul Zehngraft of JCRR.



Minimum timber demand from growing stock in Taiwan, forecast on the assumption of a demand of 1,300,000 cu.m. in 1957 and an increase in population of 140 percent in 40 years (3.5% of 10,000,000 annually).

Marketing

Timber production is adversely affected by several factors related to processing and marketing. Special attention should be given to the price situation.

At present there are three distinct levels of prices for timber products: (1) market, (2) official, and (3) preferred. The market price is set by open competition, i.e., supply and demand. According to the Regulations of the Provincial Government the official price is to be set 3 times each month, 15 percent below the market price, for the benefit of specified military and public civilian agencies. Because of economic conditions affecting prices during the past few years a preferred price, still lower than the official price, has been established for lumber for military construction, etc. This complicated price structure has a harmful effect on the whole industry. There is a natural incentive for the Taiwan Forest Administration to sell at market price. The agencies entitled to the official price insist on enjoying the benefit of it. As a result, the private operator is in the untenable position of buying high and selling low, since the Government, through the Taiwan Forest Administration, is his major source of raw material, and through a number of other agencies, is an important segment of his market. It is a potential cause of subterfuges and other irregularities that unfavorably affect a large part of his business transactions. It retards production.

During recent months market prices have skyrocketed to a point 40-50 percent

above the official prices. This was caused by the typhoon of september 1956 which slowed down production and placed unusual demands on timber for repair of damage.

The situation is further complicated by the existence of the third, preferred price for military construction. This price is materially less than the official price made available to other agencies.

More rapid—and adequate—production might regulate prices more effectively than arbitrarily fixing an official price for selected agencies, and should be given a thorough trial.

Restrictions on private timber operations by the Government, which controls 72 percent of the total forested area, are holding back production. Private operations should be drastically expanded in low-grade hardwoods and even encouraged to carry on logging operations on other part of the National Forests.

Many procedures required by the Government retard production both by public and private operators. Among those affecting the latter, the methods of collecting taxes on forest products should be mentioned especially.

These are only examples. In view of the importance of increasing production as a means both of improving the yield of the forest and of serving economic needs of the country, a broad review should be made of the whold field of processing and marketing.

Land Use

It has already been urged that all land suitable for agriculture including pasturage be given priority for that use. It is urged just as strongly that land not suitable for long-term agriculture be devoted to forestry, both as a means of favoring the production of usable water and as a means of providing fully stocked, productive forests. In many instances this means rehabilitating denuded areas. Such areas, however, are mostly accessible, reforestation is not overly expensive, and results rewarding. Because of the ease with which this problem can be attacked an action program should be put into effect immediately, upon the completion of the current intensive land classification survey, to designate forest land (not suitable for agriculture) and, through continued reforestation and other techniques of forest management, put it in condition for maximum forest production.

Food, however, is the chief requirement of any population. Meeting this requirement in Taiwan is not simple. Climatic and soil conditions on much of

the Island are close to ideal. Density of population, however, introduces complications, and these are emphasized by Taiwan's insular position and by its high proportion of rough topography. It is self evident that an island with a population of 10,000,000 needs a substantial domestic source of food supply if it is to enjoy reasonable security. Under conditions generated by the present international situation such a need becomes imperative.

Cultivated land amounts to about 1,000,000 hectares at the present time, less than one-third of the Island. There is an additional 305,000 hectares of grassland much of it resulting from forest fires in the high country, that may offer some opportunity for pasture development or even, in a few isolated instances, for tilled crops. Either use would make a valuable contribution to the food supply of the people. However, it is likely that most of the agricultural land is already used for that purpose.

Already cultivation has penetrated too far into the forests in some localities, with sharply diminishing returns. Crop production has been a disappointment and the resulting soil deterioration has made the land, in many instances, unsuitable even for forest growth. Mismanaged forests do a disservice to agriculture. Reclothed with tree growth they can, however, render a valuable service by preventing erosion and by regulating water supplies. They should be managed for that purpose.

The intensive land-classification survey, now under way in the marginal zone of intermingled forest and agricultural land, will separate the areas that can profitably be devoted to agriculture from those that can not and therefore should be left in or returned to, the forest.

Carrying out these recommendations calls for an action program by the Government. Problems of jurisdiction and organization will arise far exceeding the technical problems of land-use planning, but they must not be allowed to stand in the way of an effective program. It is basic to everything else that needs to be done.

Opportunities and Needs for Action

The current study has been made with the assumption that as most of Taiwan's forests are nationally owned, a primary objective of foresters in Taiwan would be to manage these forests for the greatest good of all the people. This worthy objective may at times prove difficult in a country where the population pressure is so great, where living costs have mounted, and where the pay

of public servants is relatively small and the opportunities for advancement limited.

The study brought to light the fact that many constructive suggestions for improvements in forest policy and forest management have been made during the past several years but that few of them have put into effect. Although there is little radically new about the following suggestions, they are made with the thought their adoption will benefit Free China. Early action by the appropriate agencies will help speed the needed improvement in Taiwan's forestry program.

1. National Forest Law

The Forest Law was last revised and promulgated by the Central Government in 1945 for application to the Mainland. Although it does not specifically fit conditions on Taiwan it provides a generally satisfactory legal basis for the management of the forest resources of the Island. One major weakness is particularly noted: In the absence of an active Ministry of Agriculture and Forestry the administration of this resource has been assigned to the Provincial Government and is being carried on by the Provincial Department of agriculture and Forestry through its Taiwan Forest Administration. Proposals have been made for the formal delegation of this authority under Article 5 of the Forest Law. Action to do this should be taken promptly.

The need for several specific amendments has been pointed out in "Report on Taiwan Forestry" by the Forestry Inspection Group, Committee of Economics, Legislative Yuan, published in January 1955. Such amendments would be desirable as a means of authorizing land lease on the National Forests, and of clarifying the legal status of other desirable program measures. It would also provide an opportunity for appropriate action on specific items of national responsibility, such as administration of the aborigine reservations and the disposal of national forest products and other property such as logging railroads and sawmills.

It would add greatly to the effectiveness of the proposed program to include in such legislation a statement of National policy recognizing the public value of the Nation's forests and the importance of sound forest management as a measure of economic and military security.

2. Forestry Regulations

Forestry regulations should be consolidated and simplified.

A number of recommendations are being made that will call for changes in practices by the Taiwan Forest Administration and other agencies. These will require corresponding changes in the regulations. As these are prepared, an effort should

be made to be as clear and specific as possible. After these changes are completed, a comprehensive revision should be undertaken with the objective of eliminating any duplication, conflict, confusion or ambiguity that may remain.

3. Jurisdiction over National Lands

The Provincial Government, with a legal delegation of authority from the National Government, should establish clear-cut jurisdictions over the various forest properties, eliminating, for example, the type of potential conflict in the issuing of agricultural permits that impairs efficient administration at present on "undetermined forest land", obtaining additional national legislation if necessary. Similar steps should be taken to clarify jurisdictions over the experimental forests of the Taiwan Forest Research Institute and the National Taiwan University, as well as the aborigine reservations, the national parks within the national forests, and any other special areas.

4. Protection Forests

The status of protection forests and their management should be clarified. Areas so designated include some non-forested land as well as forested, cut-over as well as virgin. Some are privately owned, but most of them are in national and other public ownership. Some of them are actually being cut over at the present time even though they were set aside as a means of reserving them from cutting. Some are in cultivation. Many people feel that they are an important means of protecting watersheds and should not be disturbed by any form of timber cutting; others question whether some of the areas, at least, are serving a useful purpose under such restrictions. Still others feel that the timber in the protection forests should be "managed" instead of being merely held without any form of use. Such management, it is urged, should include measures necessary for the control or prevention of disease or insect attack, for the harvesting of mature and over-mature trees, with reforestation, and other practices designed to maintain optimum conditions for watershed protection.

Such confusion is unfortunate. High timber values are at stake in the forests and even higher values are at stake on the farm lands below them and on other areas that need continuous supplies of water and protection from floods. A number of decisions, therefore, should be made and action taken, such as the following:

- a. Determine the location of the designated protection forests on the ground.
- b. Decide whether they are properly located and whether changes should be made in their boundaries.
- c. Decide whether any areas should be eliminated and whether other areas

should be added.

- d. Establish criteria, practices, and authority for administering them, including harvesting and other stand improvement measures, and for assuring compliance.
- e. Mark all protection forests clearly on the ground and show them on maps.
- f. Recognizing that *all* forests, in accordance with the generally accepted principle of multiple use, have some watershed protection value, determine measures necessary outside of protection forests to assure maximum watershed protection, and incorporate appropriate measures in each management plan.

5. Land Classification

As soon as the land-classification survey now being made under the sponsorship of JCRR is completed, appropriate measures should be adopted by the Provincial Government to put it into effect.

6. Boundary Marking

The boundaries of all national and other public forest lands should be determined and marked on the ground as soon as possible. Adjustments should then be made through exchange or otherwise so as to assure logical boundaries.

7. Reorganization of Taiwan Forest Administration

- a. A forestry administration or high-level bureau in the Provincial Department of Agriculture and Forestry should be recognized as the over-all unified forestry agency of the Government. Such a forestry bureau should be organized and empowered, and made responsible, for coping with forestry problems and developing opportunities beyond those recognized to date, as outlined in this report.

The Director of forestry should be charged with responsibility for coordinating:

- (1) Administration of the National Forests.
- (2) Forest research.
- (3) Public and private forestry cooperation and extension.

Closer correlation is needed in many parts of Taiwan between land use for forestry and for agriculture, recognizing priorities as developed in land classification. The head of the forestry bureau as a deputy commissioner of the Provincial Department of Agriculture and Forestry, should be empowered to provide this correlation. He should also have authority to correlate research with national forest administration and with public and private cooperation. The research branch has the responsibility of providing

service and leadership for all practicing foresters throughout Taiwan by means of sound progressive solutions to the technical problems facing the profession. This service and leadership would be strengthened through such correlation. A third reason for establishing a position with strong authority would be to strengthen the director's hand in administering the pasture use of lands within the national forest found to be suitable for that purpose. These functions could be more effectively performed if the Director of forestry had the rank of deputy commissioner of the Provincial Department of Agriculture and Forestry.

- b. The last of the three functions mentioned above, cooperation and extension, needs greater recognition as means of strengthening the whole framework of forestry through correlated effort at all levels of society and government. It should include responsibility for promoting public education as well as cooperation and extension work in forestry.
- c. The opinion is often expressed that the timber resources of Taiwan should be made more readily available for industrial production. This raises questions as to how procedures can be devised for eliminating delays in making timber sales on the National Forests and for speeding up (or eliminating) action by the Forest Administration on sales of timber on other classes of forest land.

On National Forest there is at present a maximum limit of 5,000 cu.m. on individual timber sales. All sales must be approved by the head office of Taiwan Forest Administration and the Provincial Department of Agriculture and Forestry. In many cases they must also be approved by the Forestry Commission, and sometimes by the Governor. This arbitrary limit should be removed and the Director of TFA should be authorized to make sales of any size needed to adhere to the annual cutting plan as approved by the Provincial Department of Agriculture and Forestry. Field executives should be delegated authority to make sales within a maximum limit, designed only to require them to refer a small percentage of proposed sales for review by higher authority. Several other opportunities for improvement have come to our attention. Large units should be sold under long-term contracts, where appropriate, especially in less accessible areas where high costs of road construction are involved. Payment for stumpage should be made in installments, but ahead of cutting. The sale contract should provide for periodic reappraisals. Timber sale surveys should be simplified and limited to gathering data needed for the determination of

prices and for preparing a plan of operation. This need not be a 100 percent survey, but can be done by a reasonable degree of sampling. The determination of the actual volume of the product and the payments therefore should be done by scaling after the product is cut. Logging operator licenses should be eliminated and instead all purchase bids should be accompanied by a certification of qualifications.

Provision should be made in each contract for reforestation through the use of a part of the receipts by the Government for that purpose.

The present complicated price structure for forest products needs to be simplified. With an adequate lumber supply in the market, private enterprise should satisfactorily regulate prices.

With the elimination of preferred prices, all ordinary sales, with three possible exceptions, could be made on the basis of bids. The three exceptions would be (1) for very small sales, maximum size to be stipulated, (2) for other sales, within a low maximum limit, for domestic use by farmers, and (3) to remove scattered trees prior to reforestation. In addition to these exceptions the Director should be given blanket authority to make sales without competition in emergencies such as disaster relief, control of pests, or salvage of timber that is deteriorating rapidly as a result of fire, storm, insects, or disease. In such cases recent bid prices for adjacent timber would serve as a guide for determining prices.

Other ways should be sought to speed up logging on the national forests. The whole timber sale procedure should be studied carefully in an effort to bring it up to a high standard of efficiency. Experience in the United States indicates that this needs to be a continuing process.

- d. The need for carrying out the administrative policies of TFA through a unified organization is self evident. The need for making forest management the primary objective is equally self evident. Several measures have been suggested for improving the situation. One would be to convert the six logging station areas into districts, setting up thirteen coordinate territorial units with established government logging activities continuing on six of them. A second possibility would be to organize a logging branch in the Provincial Department of Agriculture and Forestry. It would be responsible for carrying on logging activities wherever they are needed to serve the requirements of forest management, much as an engineering division would be used to construct and maintain roads, buildings, and other physical improvements.

- e. A third possibility would be gradually to eliminate logging by TFA entirely and let it be done by timber purchasers or contractors under TFA supervision, which is the common practice in U.S. and elsewhere. This appears to us to be the best solution ultimately. A complete change probably can not be made immediately, but a plan of action should be adopted—probably the second alternative above—to eliminate the duplication of effort and the conflicts that result from the present organization. Thus ultimately TFA will be enabled to devote its attention more fully to managing the forests for the benefit of the public rather than for the purpose of showing a profit on the balance sheet.
- f. The preparation of management plans should be done by technical foresters who are working in the woods and are responsible for putting the plans into effect. At present too much of this work is done in an office far removed from the timber, and filed there. Up-to-date methods should be used in preparing these plans, including use of aerial photographs and sampling of forest conditions on the ground to a reasonable degree of accuracy. All such plans should be made for current use by field officers.
- g. Field administration should be strengthened with more technically trained foresters authorized to do their job with much less review than at present. This would reduce the force assigned to the central office and enable the smaller force there to devote their time and energy to major problems of central-office caliber. The reorganization of TFA should be undertaken along scientific lines such as are in common use in setting up business and industrial enterprises. It involves defining objectives, setting up standards, measuring workloads, manning, financing, and preparing regulations. It is our opinion that such a project under the guidance of a competent management consultant would point, on the one hand, to many time-consuming procedures that could be eliminated and, on the other hand, to many essential activities that could be undertaken with the manpower thus made available. Such a change is bound to be difficult for the present personnel and should be accompanied by a thorough orientation and retraining program.
- h. It is recommended that regulations for all activities be revised to streamline operations. Timber is not being made available as rapidly as it should and the revision of management plans is behind schedule. It is evident that unnecessary red tape in the form of repeated review at successive levels is to a substantial degree responsible for this. Such checking and double checking is often condoned as a means of "protecting" the Govern-

ment official's responsibilities. Not only does it result in duplicating effort but, worse than that, it keeps responsible executives tied down to their desks and out of touch with conditions on the ground. It tends to make administration both costly and unrealistic. There are, however, more effective and less costly ways of doing this. Authority for action should be delegated and accountability required. This should be "spelled out" clearly in regulations and made effective through training and supervision.

- i. Provision should be made for more adequate salaries and related compensation such as leave, retirement, and travel expenses. High professional standards should be required and professional employees should then be given full "civil service" status with freedom from political activity and pressures.

- j. Police power should be delegated to senior forest officers.

8. Construction of Forest Roads

Construction of forest roads should be promoted in accordance with a comprehensive, systematic transportation plan for the National Forests in order to make high-value inaccessible timber stands available for logging operations. The character of the problems involved calls for doing this on a plan-wise basis. It should be done promptly, however, for two reasons: (1) to facilitate salvaging the substantial volume of high-quality but overmature timber that is being lost annually through mortality and decay, (2) to determine more exactly, as a basis for preparing sound timber management plans, what timber, now classified as inaccessible, should be classified as potentially (economically) accessible.

9. Leasing of National and Public Forest Lands for Agriculture

Leasing of public forest lands for agricultural purposes has sometimes led to exploitation of timber values, with no development of agriculture or with such development on land unsuited to agriculture. No forested land should be cleared for agricultural purposes unless that is its best use, as determined by land classification. It is therefore recommended that public agencies discontinue leasing for agriculture unless it has been classed as agricultural land. If it is then leased, it must be developed for agriculture or the leasee be made subject to legal action.

10. Undertermined Forest Lands

It is recommended that "undetermind forest land" be turned over to Hsiens and municipalities in which it lies for management by them under cooperative agreements or other grants of authority from the Provincial Government. Provision should be made for the participation of the Provincial forestry bureau in the

preparation and approval of management plans and in such supervisory activities as inspection, training, concurrence in the selection of principal personnel, etc. Where such areas border on the national forests, some minor transfers of land may be desirable in order to have a logical, reasonably smooth, boundary line between the two jurisdictions.

11. Land-Lease Reforestation

Land lease has been used as a successful method of encouraging tree planting activities on public land through cooperation between local government agencies and private individuals or groups. Its use should be expanded, especially on the National Forests, in order to speed up reforestation, with considerable savings to the Government and an opportunity to increase the income of private cooperators. National forest areas in need of replanting should be offered for lease at periodic intervals through public advertisement, with award going to the highest bidder. Other forms of cooperation should be continued and expanded to speed up planting of idle lands.

12. Forest Production

Forest production should be expanded to help Taiwan meet the present and future needs of its people for timber and other forest products, at reasonable prices. Taiwan forests are now growing at an average of less than a third of their potential capacity. To increase production and to take fuller advantage of the land capabilities for forest production, certain steps should be taken:

- a. The operable old virgin forests of the inaccessible interior of the Island covering 19 percent of the total forested area is deteriorating each year and should be made accessible, logged and replanted as soon as possible. This will prevent further losses due to tree mortality and will enable this large area to become productive. Construction of new roads is needed to make these stands available for harvest, and should be pushed rapidly.
- b. Much of the land covered by hardwood stands (79 percent of Taiwan's accessible forested area, including bamboo) has been heavily overcut and badly managed in the past. It is now understocked or denuded and is in need of a salvage cutting to get it back in to productive condition. This will usually involve clear cutting, to be followed by planting to conifers or valuable hardwoods. This measure should be given high priority in the forestry program. Since the yields are low this timber can not be harvested economically by TFA. The harvesting therefore should be done by private operators.

- c. All available denuded or seriously understocked forest land, including much of the hardwood type, estimated at about one million hectares by the forest survey, should be planted to forest trees during the next 30 years. This will include 13,000 to 14,000 hectares of forest land cut over every year hereafter.
- d. All forest land should be given protection from fire, injurious insects and diseases, and theft. This will necessitate constant training of field personnel, the continual supervision of all public forest areas, and the cooperation of research agencies.

13. Forest Utilization

Utilization practices can be improved in various ways and thus greater amounts of needed wood products can be obtained with a consequent saving of the forest growing stock. These include:

- a. Increased use of material now left on the ground after logging.
- b. Increased cutting of defective and poor quality trees before they die, mostly in accessible hardwood stands.
- c. More use of preservative-treated wood, to insure longer life of the product. There are two pressure-treating plants now in operation in Taiwan with facilities for treating railroad ties, poles, and other wood products; but many wood products are not yet treated.
- d. High quality wood should not be used for purposes for which lower grades are suitable; for example, cypress (hinoki) is often used for temporary construction purposes, railroad ties, etc., when other species are perfectly well fitted for this purpose, especially when treated.
- e. More attention should be given to developing the many forest products other than timber (multiple use). High among these is turpentine and rosin for which conditions seem favorable in Taiwan.

14. Log and Lumber Standards; Tax Collection

Efficiency in timber production requires standardization of grades and dimensions. Such standards are complicated in Taiwan and should be simplified.

Behind present confusion is a sudden adoption in recent years of the metric system after 50 years of Japanese foot dimensions. Moreover, many building materials in the world market such as plywood are standardized on a foot basis.

Some very constructive work has been done on this subject by logging engineers

of the J. G. White Corporation in Taiwan and recommendations for improving dimension standards have been presented to the Central Standard Bureau, which is working through the organized architects on material for publication. Real progress has been made in working out metric dimensions that fit inches (for thickness and width), but length (meters vs. feet) present greater difficulties. This is an important project and should be pushed.

Log and lumber grades are unnecessarily complex. For conifers there are 2 classes each comprising 5 grades. For hardwoods there are 3 classes. Grading should receive careful study looking to simplification. It not only impairs efficiency but adds to the complexity of the price structure for forest products.

Tax collection on forest products should be simplified. Consideration should be given to combining it with the purchase price or otherwise having TFA collect it at the same time the purchase price is paid.

15. Exports of Forest products

Attention has been directed elsewhere in this report to the fact that although accessible timber is being cut more rapidly than it is being replaced, large volumes of overmature timber, both accessible and inaccessible, are being left untouched, to die and deteriorate. Since it is currently being lost at a rapid rate through mortality, no limits should be placed on the rate at which it is removed beyond those imposed by physical obstacles and sound economics. Timber production in Taiwan could thus be increased to such an extent that it would substantially exceed local demands. The superior quality of much of the timber so produced would provide a high-value potential export item which would contribute toward a favorable balance in foreign trade for Free China as production is expanded beyond domestic needs and prices brought down to the point that they can compete with those of the outside.

16. Encouragement of Private Forest Industry

For many years the Provincial Government has been carrying on active operations in logging and sawmilling of forest products from the logging station areas. Currently the 15 government sawmills turn out between 10 and 15 percent of the lumber produced in Taiwan, and operate at 80 to 100 percent of capacity, whereas the private mills (644 in 1954) are operating at only about one-third capacity. Other industries in related fields, such as veneer, plywood, synthetic wood, pulp and paper, etc., are similarly cramped in their production. It would seem wise for Government gradually to turn their logging and sawmilling operations over to private industry. This would assure more economical operations, with a resulting increase in production and lowering of market prices. Most of the raw

material would still come from public forest where the government foresters could concentrate more of their time and efforts on forest protection and management activities.

17. Prices of Forest Products

The following suggestions are offered for improving the price situation:

- a. Increase production through measures proposed elsewhere in this report.
- b. Eliminate the special preferred price for military construction.
- c. Limit the benefits of the official price to those agencies financed by Government appropriations.^{1/}
- d. Work toward the elimination of any charge for TFA stumpage to Government agencies. This amounts merely to taking money out of one pocket and putting it into another. For statistical purposes, record the value of Government stumpage furnished for such use, give TFA credit, and drop the accounting there. Transfers of appropriations could then be made for services in processing the raw material.

18. Allocation of Forest Products by TFA to Other Agencies

Forest products made available by TFA for use by other agencies should be produced according to specifications and in volumes to meet actual stated needs and limited accordingly. Grades and volumes in excess of actual needs should not be permitted. Exchanging through private channels of material obtained through allocation for larger amounts of lower grades should be forbidden and strictly policed.

19. Public Education and Extension

In order to attain better appreciation for the importance and value of its forest resources, (a) the people of Taiwan should be informed currently of the status of forestry and the work of its public agencies in that field, and (b) private forest land owners and operators should have the benefit of expert technical advice. This is a continuing job for all forestry personnel, but a separate division should be set up in the Provincial Department of Agriculture and Forestry to handle these activities, working in close cooperation with forest research agencies throughout the Island. Material should be released currently to newspapers and through educational pamphlets, speeches, and through personal contact in the field to better inform the public on forestry matters.

^{1/} It is understood from TFA that 40 percent of the logs and rough lumber sales currently are on the basis of open bids and that no "official price" sales have been made to lumber dealers since October 1956.

20. Recreational Use of National Forests

The National Forests of Taiwan include many areas of great scenic beauty which make them attractive for tourists and others interested in nature and outdoor life. When the present inaccessible mountain areas are opened up by roads, the National Forests will become even more of an attraction. Harvesting of forest crops should interfere little with the recreational use of the National Forests, although a few small selected areas might be set aside to maintain wilderness conditions where they will prove particularly attractive to visitors.

21. Forest Research

The current forest research program under way at the Taiwan Forest Research Institute should be closely tied in with TFA according to the recommendation made under 7a.

The programs of other agencies conducting forest research in Taiwan, including the National Taiwan University and the Taiwan Provincial College of Agriculture should be correlated by frequent exchanges of information and reports, and annual research program conferences.

The present Taiwan Forest Research Institute Advisory Council is an excellent device for reviewing current programs and helping to determine the relative importance of all research projects. It should be continued.

Research programs should be realistic and designed to answer the important problems of forest land owners and managers in Taiwan. Projects that do not fall into this category should be dropped or postponed. This should be determined by the preparation of a detailed forest problem analysis for the Island, a job for Taiwan Forest Research Institute to undertake in cooperation with TFA.

Every encouragement should be given to developing an adequate forest research program for Taiwan, including additional training and education for the research staff, adequate funds, equipment, forest areas for research and other facilities needed.

22. JCRR Forestry Program

The JCRR has brought about advances in many fields of forestry since it established a Forestry Division under Paul Zehngraff in 1951. The JCRR forestry program has been particularly helpful in pointing out overall forestry needs of Taiwan, and many of its recommendations have been put into effect. One of its most important accomplishments has been assisting in the carrying out of the comprehensive forest survey of Taiwan from 1954 to 1956. Another important

project has been to stimulate the local government agencies (hsiens & hsiangs), private citizens, and cooperative organizations to embark on cooperative forest planting programs.

It seems desirable that the JCRR continue to encourage progressive forestry measures by provincial and local governments until these agencies are organized to carry on without further outside aid.

行政院農委會圖書室



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