

# PROJECT PROPOSAL

## Integrated Pest Management of the Cotton Boll Weevil In Argentina, Brazil and Paraguay

CFC/ICAC 04

**INTEGRATED PEST MANAGEMENT OF THE COTTON BOLL WEEVIL  
IN ARGENTINA, BRAZIL, AND PARAGUAY**

Financing Summary

<u>Sponsoring ICB</u>	:	International Cotton Advisory Committee (ICAC)
<u>Recipient</u>	:	ICAC
<u>Project Executing Agency</u>	:	Instituto Argentina de Sanidad y Calidad Vegetal (IASCAV)
<u>Supervisory Body</u>	:	ICAC
<u>Location of the Project</u>	:	Argentina, Brazil and Paraguay
<u>Duration of the Project</u>	:	Five years
<u>Objective and Scope of the Project</u>	:	The project's main objective is to develop and subsequently introduce Integrated Pest Management Methods for the control of the cotton boll weevil. The project would adapt and improve the Integrated Pest Management methods, including farming systems and biological controls already applied in the control of boll weevil in North and Central America; identify new natural enemies of boll weevils in Argentina, Brazil and Paraguay and evaluate their effectiveness along with those already being used in North and Central America; investigate the genetic base for resistance to boll weevil, as well as the resistance of boll weevils to the chemicals being used for their control. The socio-cultural factors which may influence the adoption of the technology will be studied and incorporated in the strategy for dissemination. A unique approach of the project is the involvement of producers in the technology development and a wide dissemination of the control methods in the countries concerned.
<u>Total Project Cost</u>	:	US\$ 8,213,170

<u>Amount of Fund Financing</u>	:	Grant: SDR ..... (equivalent to approximately US\$ 1,971,280 <sup>1</sup> )												
<u>Counterpart Contribution (by Sources)</u>	:	<table> <tr> <td>Argentina</td> <td>US\$ 2,326,290</td> </tr> <tr> <td>Brazil</td> <td>US\$ 2,564,960</td> </tr> <tr> <td>Paraguay</td> <td>US\$ 1,334,600</td> </tr> <tr> <td>ICAC</td> <td>US\$ 16,040</td> </tr> <tr> <td></td> <td>-----</td> </tr> <tr> <td>Total</td> <td>US\$ 6,241,890</td> </tr> </table>	Argentina	US\$ 2,326,290	Brazil	US\$ 2,564,960	Paraguay	US\$ 1,334,600	ICAC	US\$ 16,040		-----	Total	US\$ 6,241,890
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Previous Assistance to the Sponsoring ICB:

1)

<u>Title of Project</u>	:	Study of Cotton Production Prospects for the Nineties
<u>PEA</u>	:	IBRD
<u>Amount of Assistance</u>	:	SDR 389,879 (Grant)
<u>Board Approval Date</u>	:	13 October 1992
<u>Effectiveness date</u>	:	25 November 1992
<u>Closing Date</u>	:	31 March 1995

2)

<u>Title of Project</u>	:	Integrated Pest Management for Cotton
<u>PEA</u>	:	Israel Cotton Production and Marketing Board Ltd.
<u>Amount of Assistance</u>	:	SDR 2,192,274 (Grant)
<u>Board Approval Date</u>	:	29 March 1994
<u>Effectiveness Date</u>	:	Not yet effective
<u>Closing Date</u>	:	30 September 1998

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<sup>1</sup> For SDR valuation of the project, please see document CFC/EB/13/INF.5 (copy attached).

## **ABBREVIATIONS AND ACRONYMS**

<b>EMBRAPA</b>	-	<b>Empresa Brasileira de Pesquisa Agropecuaria</b>
<b>IASCAV</b>	-	<b>Instituto Argentina de Sanidad y Calidad Vegetal</b>
<b>ICAC</b>	-	<b>International Cotton Advisory Committee</b>
<b>ICB</b>	-	<b>International Commodity Body</b>
<b>IPM</b>	-	<b>Integrated Pest Management</b>
<b>MAG</b>	-	<b>Ministerio de Agricultura y Ganaderia (Paraguay)</b>
<b>PCR</b>	-	<b>Project Completion Report</b>
<b>PEA</b>	-	<b>Project Executing Agency</b>
<b>SB</b>	-	<b>Supervisory Body</b>
<b>SOE</b>	-	<b>Statement of Expenditure</b>
<b>TOR</b>	-	<b>Terms of Reference</b>

## **APPRAISAL AND RECOMMENDATION OF THE MANAGING DIRECTOR TO THE EXECUTIVE BOARD**

### **Integrated Pest Management of the Cotton Boll Weevil in Argentina, Brazil and Paraguay**

1. The Managing Director hereby submits the following Appraisal and Recommendation on a proposed financing assistance to the International Cotton Advisory Committee (ICAC) for SDR..... (equivalent to approximately US\$ 1,971,280)<sup>2</sup> in the form of a grant to assist in financing the project "**Integrated Pest Management of the Cotton Boll Weevil in Argentina, Brazil and Paraguay**". The International Cotton Advisory Committee would be the Supervisory Body.

#### **PART I. INTRODUCTION**

##### **A. Project Background**

2. The project was first submitted to the Fund by the International Cotton Advisory Committee in January 1993 and presented to the Consultative Committee at its seventh meeting, in May 1993. In its first version, the project focused on the development and introduction of integrated pest management practices with regard to the cotton boll weevil in Argentina and Paraguay only. The Committee acknowledged the relevance of adequate boll weevil control for profitable cotton production in both countries, and the positive environmental impact of the introduction of integrated pest management practices. In its recommendations, the Committee emphasized, however, the importance of the inclusion of Brazil in the project, considering the wide occurrence of the boll weevil in that country. The project foreseen would be of limited value without the participation of Brazil, as that country will be a source of reinfestation and spread to other countries in the region.

3. A revised version of the proposal was presented to the Committee at its ninth meeting in January 1994. The Committee noted the inclusion of Brazil in the project, but also concluded that its participation, other than the provision of a significant counterpart contribution to the project, had not been substantiated in the activities to be implemented by the project. In addition the Committee request that: the activities along with the work plan to be implemented to achieve the goals of the project be elaborated and a clear arrangement for the management of the project be specified. The project proposal had meanwhile also been reviewed by an external consultant. It was decided that the observations made by the consultant, in addition to the recommendations made by the Committee, would be made available to the ICAC, and used in modifying the project proposal.

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<sup>2</sup> For SDR valuation of the project, please see document CFC/EB/13/INF.5 (copy attached).

4. A thoroughly revised project was subsequently submitted and presented to the Committee at its 11th meeting in July 1994. The Committee concluded that the revised proposal had adequately met the concerns of the Committee expressed at its earlier meetings. It, however, emphasized the need to involve farmers early in the process of technology development, trials and evaluation of technology. Less emphasis should be placed on computer modelling; apart from studying the boll weevils and associated agroecosystem, its predators and parasites, as well as methods and timing of chemical application should be studied; geographical information system based on Landsat and aerial photographs should be supplemented with socio-economic factors and cultural practices; and cotton stock destruction should be undertaken without soil degradation. The Committee agreed with the objectives, scope and design of the project, and concluded that the project adequately falls within the strategy of the ICAC and that the project is in accordance with the objectives and the mandate of the Fund. The Committee therefore recommended that the project be submitted to the Executive Board for consideration and approval.

## **B. Overview of the Commodity and the Related Background**

5. Cotton<sup>3</sup> as an agricultural raw material commodity is a major export crop in both the developing and developed countries. The latter account for about 55% of the world's output and the developing countries and territories account for the remainder.<sup>4</sup> Based on the average of the last three years' figures, cotton is one of the few major commodities whose global production more or less match world mill consumption. However, increases in output are expected during the last half of the decade. Most of the increases will be from the United States of America, India, Pakistan, Australia, Argentina, China, Brazil, Egypt, Turkey and the Central Russian Republics.<sup>5</sup>

6. Compared to cotton producers in the developing countries, cotton producers in the United States of America, which account for about 10% of the global production are in the best position to react to changing market trends and adjust their output by virtue of a range of infrastructure and farm policy support measures. The main instruments used include an efficient farming system backed by an advanced distribution network and marketing system, post-harvest technology, modern information & telecommunications systems and more importantly, a flexible Farm Bill which regulate output through a system of production ceilings.

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<sup>3</sup> Cotton, as referred to in this current economic survey of the commodity, implies only to ginned lint, or raw cotton. The statistics on cotton does not include cotton textile production, export or imports; it does not include linters, seed cotton, cotton mill waste, or cotton fibres subjected to any process other than separation of the lint from the seed by the cotton gin.

<sup>4</sup> Unless otherwise specified, annual data for the cotton crop year begins every 1 August.

<sup>5</sup> Source: ICAC, Cotton Production Prospects in the Nineties, An Overview; January 31, 1992, Washington, DC.

7. The cotton market is dominated by major consumers, with China accounting for about one-fourth of the world's mill consumption. Other major buyers of cotton are South Korea, Taiwan, Japan and the EU, with USA coming out as a net exporter despite its high mill consumption. The major market for cotton trading is the New York Commodity Exchange. On 25 January 1994, the New York Commodity Exchange settlement price for March cotton was quoted at 73.06 cents per pound at 50,000 pounds lot size on heavy volume of trading (Source: Financial Times, Commodities Section, 26 January 1994). One year projection based on the futures market indicates a relatively firm market with only a 4-cent price differential for March 1995 cotton, with a less than one cent spread between bid/ask quotations.

8. The world stocks have been relatively stable around 9 million tonnes in the past three years. It is projected that the cotton stock in the next two years will increase by another 3 million bales (653,000 tonnes). A continuing decline in petroleum prices, as witnessed in 1993, will increase the competition from synthetic fibres. The expected decline in cotton prices resulting from increased supply and growing competition from synthetics, calls for, *inter alia*, measures to improve quality and reduce cost of production.

### **C. Project Related Institutions**

9. The International Cotton Advisory Committee, which is the sponsoring agency, will be the Supervisory Body. It has the capacity and resources to assume the supervisory role for this project. The ICAC is an association of governments having an interest in the production, export, import and consumption of cotton. It is an organization designed to promote co-operation in the solution of cotton related problems, particularly those of international scope and significance. Its members accounted for more than 80 percent of the world cotton exports and more than half of the imports.

10. One of the key concerns of the members of the ICAC is the ongoing competition with synthetic fibres. Lower cotton prices vis-à-vis synthetic fibres should ensure that cotton remains competitive. In order to improve producer incomes, maintain the cotton share of the market, cost of production must be curtailed, yields and quality of cotton will have to increase. The members of the ICAC have, therefore, given highest priorities to projects which address the loss in yield, improvement in quality of cotton, and reduction in cost of production. ICAC has identified cotton plant pests as the most important limiting factor for increased production of quality cotton. The sweetpotato whitefly (*B. tabaci*), cotton aphid (*A. gossypii*) and cotton boll weevils have been identified as cotton pests, causing most damage to cotton production. Considering the costs and environmental problems of controlling these pests by chemicals, ICAC has increasingly emphasized control by Integrated Pest Management. Given the fact that most developed cotton producers have the means to address these issues, whereas the developing cotton producers can not do so, the ICAC has acknowledged the importance of exchange of technical information between member countries and the need for greater co-operation in the solution of mutual problems. The proposed project is an example of this prioritization and the recommended international co-operation.

11. Argentina: The Instituto Nacional de Tecnologia Agropecuaria (INTA) at Saenz Pena will be the collaborating institution in Argentina. INTA is an independent organization under the Undersecretary of Agriculture, Animal Husbandry and Fisheries. It was created in 1956 and has the mandate to promote and strengthen agriculture research in Argentina. Within the INTA, the Coordinator for the Cotton Program is responsible for research on cotton. INTA is also responsible for the development of appropriate cotton production technology and transferring it to cotton growers with the help of rural extension agencies. The Coordinator for the Cotton Program also coordinates other national and international programs. The INTA decides research priorities in cotton and also provides funds for research.

12. Brazil: The Brazilian Enterprise of Agricultural Research (EMBRAPA) within the Ministry of Agriculture and Agrarian Reforms will be the collaborating institution in Brazil. EMBRAPA is responsible for research on cotton. All federally funded research programs on cotton are implemented through the Centro Nacional de Pesquisa de Algodao (CNPQ) at its headquarters in Campina Grande, Paraiba. The CNPQ has two research stations for testing of breeding material and other technological developments. The CNPQ has strong ties with cotton research programs of various states who are responsible for transfer of technology to growers. The CNPQ is also responsible for coordination and exchange of research findings among cotton researchers.

13. Paraguay: The Instituto Agronomico Nacional (IAN) (at Caacupe) will be the collaborating institution in Paraguay. IAN is the main agricultural research institute in Paraguay. IAN was designed by the Servicio Tecnico de Cooperacion Agricola, a branch of USA aid programs in 1943 and has since 1968 been fully managed by Paraguay. The IAN is a multidisciplinary research center that develops genetic, agronomic, phytosanitary and soil research for the country. It is also the center of experimental stations in Paraguay.

14. The Instituto Argentina de Sanidad y Calidad Vegetal (IASCAV) will be the PEA for the Project. This agency is responsible for the phytosanitary control in Argentina. IASCAV was established on 29 October 1991. It is a decentralized and self-supporting body under the Department of Agriculture, Meat and Fish of the Ministry of Economics and Public Services. IASCAV is a relatively small organization, though faced with very important tasks to accomplish. The institute is managed in a harmonious, centralized way, however, allowing to cover the entire national territory. IASCAV counts on a network of 650 agencies and 43 agricultural delegations and sub-delegations spread all over the country. It has in the last year worked very closely with INTA in Argentina, IAN of the Ministry of Agriculture in Paraguay and CNPQ in Brazil. It has been chairing binational (Argentina and Paraguay) meetings to assess and discuss efforts to control the boll weevil.

#### **D. Previous Support to the Commodity/ICB**

15. The Executive Board has approved earlier two projects which were sponsored by the International Cotton Advisory Committee. The first one, entitled: "Study of Cotton Production Prospects for the Nineties", was approved in 1992. It consists of a nine country/case studies examining the factors contributing to the differential cotton industry performance and will outline the present and future challenges, and the opportunities facing them. Particular attention will be given to the apparent influence of government policies on the strategic patterns of development and adoption of technology, farm-level productivity and the efficiency and effectiveness of processing and marketing operations. The Study is particularly policy oriented. The draft country reports and related analysis will be presented at an international workshop to

be held in Egypt, in November 1994. The implementation of the project has been satisfactory and ICAC has provided necessary supervision. The disbursement under the project stood at 81 % of commitment by 30 June 1994.

16. The second project, entitled: "Integrated Pest Management for Cotton", was approved in March 1994. The project focuses on the development of environmentally sound pest management practices aimed at reducing the impact of two major cotton pests (sweetpotato whitefly and cotton aphid), responsible for the contamination of cotton with a sticky honeydew. This contamination has a negative impact on both yield and quality of the cotton. The project is located in Israel and Egypt, with field trials in Ethiopia and Zimbabwe. The project is expected to be operational before the end of 1994.

17. The amount of funding made available for the cotton projects is at present SDR 2,582,153 which is approximately 18% of the total assistance of the Fund for all commodities (as approved by the Executive Board up to EB/15).

## **PART II. PROJECT DESCRIPTION**

### **A. Project Rationale and Objectives**

18. The cotton boll weevil *Anthonomus Grandis* Boheman is considered to be the most destructive pest of the cotton crop in the American Continent. It was first discovered in the USA (Texas) in 1892 and within 30 years it has infested the entire South Eastern part of the country. It spread to Venezuela in 1949 and to Colombia in 1950. It was thought that the boll weevil could not spread further south, as the Amazon jungle was considered an adequate barrier. However, in 1983 the boll weevil was detected in Brazil. It is estimated that some 90 % of the cotton growing area of Brazil is now infested by the boll weevil. The pest has also spread throughout the cotton growing regions of Paraguay and it is estimated that 35,000 ha of cotton are now affected. In 1993 the boll weevil was detected in Argentina in the areas bordering Paraguay. It is expected that the pest will quickly spread over the Argentinean cotton production areas.

19. In both Brazil and Paraguay the infestation by cotton boll weevil has severe social and economic consequences. In Brazil, 60 % decrease in cultivated area has been associated with cotton boll weevils, and the cost of control is estimated at US\$ 78 million per annum. In Paraguay production has dropped by over 30 %, representing a loss of over US\$ 160 million per annum. Similar socio-economic impacts are expected in Brazil once the boll weevil fully establishes itself in that country. There is the possibility that boll weevil will spread to other countries in the region unless urgent action is taken to control its movement.

20. In the three proposed countries, control is effected by the use of insecticides which constitutes ecological and biological risks. The usage of toxic insecticides is not only polluting the environment, but also causing development of resistant insects, destruction of natural biological control agents of not only boll weevil but of other crops' pests. Smallholders in both Brazil and Paraguay have particularly suffered from reduction in crop yields and increase in production cost resulting from increased crop pest infestation. Due to its negative secondary effects, the use of chemicals for control has not proved effective in the long run in North and Central America. The only approach that has proven effective with minimum negative environmental impact is the Integrated Pest Management including the use of suitable cultural practices and biological control, and limited application of broad-spectrum chemicals. While the

control practices in North and Central America cannot be transplanted wholesale, due to differences in socio-cultural and agricultural production system, the proposed project will build on the existing experiences to ensure quick results at minimum cost. In order to adequately control the boll weevil, while minimizing the need for chemical use, the project will focus on the development of cultural and biological controls and resistant germplasm. This knowledge and experiences gained in the control of boll weevil in North and Central America will be assessed for its usefulness in the context of socio-cultural, ecological and agricultural systems within which cotton is produced in Brazil, Argentina and Paraguay to ensure the production of locally acceptable and effective control methods which have a limited environmental impact.

21. The overall objective of the project is the development and subsequent dissemination of low cost, socially accepted and environmentally positive systems of Integrated Pest Management that will be able to effectively control the cotton boll weevil.

## **B. Description of Project Components**

22. The project would comprise of the following five components: (i) evaluation of existing knowledge and identification of functional elements useful for the development of location specific control packages, and a definition specific regional strategic plans; (ii) study of the boll weevil and its associated cotton agroecosystems, including identification of its predators and parasites in the three countries; (iii) development of pest management practices and systems based on the acquired IPM technology for the different production systems; (iv) transfer of technology to farmers, and extension staff; and (v) project management, monitoring and evaluation.

### **(a) Evaluation of existing knowledge, and identification of functional elements useful for the development of location specific control packages, and definition of specific regional strategic plans**

Extensive experience has been gained by scientists and cotton technologists in North and Central America in the field of integrated pest management systems for the control of the boll weevil. These experiences cover recommendations on cultural practices i.e.: growing of uniform crop using high quality seeds; good field sanitation to prevent a build up of pest; use of relatively early maturing variety with only one fruiting cycle; crop trap, pick-up or destruction of infested flower buds and fruits; delayed uniform planting; and reproductive diapause control programme. Biological enemies of boll weevils have also been identified and used for control. These recommendations have been used widely in various forms for cotton boll weevil population management. Lessons from experience have shown that a successful strategy for IPM control must fit within socio-cultural situation of producers and the production practices in the concerned region. For example, the success from delayed uniform planting and field sanitation will depend on adherence to these cultural practices by 100 % of the farmers in the production region.

The proposed project will build on the experiences from North and Central America to develop the strategy for the control of cotton boll weevil in the proposed three countries. It is proposed that these experiences will be presented and analyzed with particular emphasis on their usefulness in developing IPM systems for the control of boll weevil in the three targeted countries. For this purpose a high level scientific workshop is scheduled at the beginning of the project, where scientists, who have been involved in the IPM programme for the control of cotton boll weevils in the cotton producing countries

of North and Central America will share their knowledge with colleagues from Brazil, Argentina and Paraguay. The emphasis will be on determining the functional biological and ecological features of boll weevil control practices for possible adaptation to location specific circumstances, including socio-cultural situation of local society and agricultural production systems in the project area. The workshop will also feature new and developing research and technology, in areas such as pheromone chemistry and behaviours, and diapause technology. The conclusions of the workshop will be published and provide the basis for developing the strategy of development under the project. The workshop will establish linkages with scientists throughout America in IPM control of boll weevil.

Following this workshop, experts in the three countries will prepare for each country detailed descriptions of edaphic conditions, the agroecological conditions of major production areas and their farming system characteristics, socio-cultural environment of producers, as well as production constraints including labour and machinery will also be analyzed. A second workshop which will include extension specialists, scientists from the three countries and those from outside who participated in the first workshop and farmers will be convened to analyze the information and conclusions of the first workshop, and the findings of the studies on cotton production systems in the three countries and bring out their implications for developing IPM control systems in the three countries. The outcome of this consultation and review process will be the development of region-specific strategic plans for the development of IPM systems for the control of the cotton boll weevil, focusing the research and technology transfer priorities for the overall programme on the needs perceived in the region and particularly by producers.

The proceedings of both workshops will be published in a Technical Manual. This manual will be prepared in the form of a 'working document' that will be updated whenever new information becomes available in the course of the project. It will be made available to scientists and producers in the region for use.

#### **(b) Study of the boll weevil and its associated cotton agroecosystems in the three countries**

Genetic resistance of boll weevil to chemical control measures is the greatest problem of long-term chemical control of boll weevil. It has been confirmed in the United States, Mexico and Central America that boll weevils in the region are increasingly becoming resistant to chlorinate hydrocarbons, organophosphates and pyrethroids. Since current control measures are based on these chemicals, it will be important to monitor the effectiveness of chemical control in the three countries and anticipate chemical control failures. Therefore, the project will establish methods and protocols for resistance monitoring. The system will include testing of adult weevils reared from squares or bolls/flower buds without artificial diet when they are 3-7 days old. The effects of chemicals on boll weevil predators and parasites as well as their impacts on their population will also be studied. The methods developed will be disseminated in the three countries for a systematic monitoring of boll weevil resistance and impacts on the population of predators and parasites.

Characterization of the feeding and pollen foraging behaviour of adult boll weevil will be undertaken to establish the dependence of boll weevil on cotton for its survival. Sources

of food for boll weevil, particularly during the fallow seasons will also be studied. The food resource and feeding behaviour of boll weevil have not been considered in past studies as factors for determining management methodologies. Other hosts used by boll weevil for reproduction will also be studied to establish methods for population suppression.

The adult population dynamics and feeding behaviour will be studied using modified in-field traps to trap adult boll weevils. Analysis will be carried out to determine the feeding materials. The information provided will be used to determine the length of survival, reproductive and diapause of boll weevil adults on various pollen foods and other hosts. Studies will be carried out to determine location specific movements and dispersal patterns throughout the year. The findings with regard to feeding behaviour and population dynamics will be incorporated into a geographical information system, and used to develop cultural practices as a control measure.

Identification and use of biological control agents for boll weevil control will be undertaken. Biological control measures appear to have more potentials for less intensive cotton production as practised by smallholders and in tropical and sub-tropical regions to which the parasites and predators are more adapted. Over fifteen parasites and predators that have been identified will be closely studied. Further studies will be carried out to identify biological control agents (parasites, predators and pathogens) in the three countries concerned. New methods will be developed for mass production of identified boll weevil control agents on artificial diets. A start in this respect will be made with *Catolaccus grandis*, a parasite wasp which has proved effective in full season control in three years of field trials in Texas, when released weekly and at the rate of 400 pairs per hectare. *Catolaccus grandis* will be imported and mass produced for field trials in Brazil and Paraguay.

Attempt will also be made to develop genetic resistance in cotton to boll weevils. Activities in this regard will include: identification of specific characters and parent germplasm that possesses clear potential for genetic resistance to boll weevil or benefit to biological control agents of boll weevil; and conduction of field tests to assay the potential genetic resistance to boll weevil and to determine the overall population suppressive effect of the germplasm.

**(c) Development of pest management practices and systems based on the acquired IPM technology for the different production systems**

The existing information on boll weevil pest management will be sieved to compile relevant practices applicable in the project area. These practices will be combined with additional information which will be generated through the project efforts in research and trial (paragraph 22(b) above). The pest management practices so derived will be tried, adapted and validated for different production systems. Life Cycle Data will be validated to confirm basic life history parameters for boll weevil in participating countries. Activities in this regard will include determination of life cycle duration and fecundity budget data for boll weevil from Brazil, Argentina and Paraguay. A field assessment of traps/kill devices for boll weevil control will be carried out to develop trap indices. Tests will be conducted in two producing areas of each participating country to fully establish the effectiveness of traps and other killing devices. The obtained results will be integrated into a simulation model of boll weevil and cotton crop already developed in Brazil. In

consultation with farmers and extension experts phenological information that can be used by cotton extension experts and farmers in making crop management decisions will be developed using this model. Farmers/extension experts workshop will be conducted to identify components that may be most useful.

The development of a new economic threshold concept will guide control decisions in a comprehensive manner, taking into account all relevant factors, like plant growth, fruit load status, population of the boll weevil and other pests as well as the presence of biological control agents. This information which will be available from the field operations of the project will be supplemented by geographical data from Landsat and other stationary imaging satellites to locate and define cotton production areas in Brazil, Argentina and Paraguay. In order to facilitate the manipulation and use of collected data, the project will provide for the installation of a Geographical Information System (GIS) with databases. Brazil will be the principal site for its region-wide development. After initial establishment of this computer-based system for decision support, routine guidelines for its use will be developed and field trials will be implemented. The actual system will be in place by the end of project year one. Feeding the system with information and the performance of trial runs and testing will be a continuous activity throughout the remaining period of the project. A computer aided decision system for boll weevil population management developed in North America cannot be used in the project area, therefore, a new system will be developed. The system will provide information on: economic threshold concept that can be used for pest management decisions for boll weevil and other cotton crop pests; and simplified methodology that can be used in the field by extension officers and farmers to make control decisions under real field situations.

#### **(d) Transfer of technology and information to farmers and extension agricultural experts**

Early in the project, activities will be implemented to train farmers and technicians to correctly identify the various life stages of the boll weevil and its biological control agents. Workshops will be held in each country to introduce boll weevil control by means of IPM, and to familiarize the producers with the methodology as well as with the actual implementation of the recommended practices. Extensive demonstration of the technologies with active participation of farmers and extension experts have been planned. Technologies confirmed through successful demonstrations will be further spread to other production areas *inter alia* through farmer-to-farmer meetings. The project foresees sixteen demonstration sites, strategically located to represent variations in production conditions. Eight of such demonstrations are planned for Brazil, and four each for Argentina and Paraguay. Twenty four educational workshops will be held in each country to expose farmers, extension officers and scientists to the IPM for cotton boll weevil control. Farmers will be organized into boll weevil control committees to assist in dissemination and implementation of pest management strategies.

In order to adequately assess the level and the impact of the introduction of the new pest control methods, an impact evaluation procedure will be established. This will include the establishment of pre-project situation through an initial survey which determines the current control practices and the extent of boll weevil infestation. These surveys will include a description of the economics of production, socio-economic conditions, labour requirements (including gender-related division of work), pesticide use (including

assessment of exposure to toxic chemicals), etc. The result of this survey will also be used for the design of strategy of development under the project (paragraph .....). In the last two years of the project surveys will be repeated in order to provide a comparative analysis of the impacts of the project in economic, social and environmental terms.

Two international scientific symposia will be organized. Cotton and crop protection specialists from around the world will be invited to review the findings of the project. It is envisaged that one symposium will take place in Brazil in the third year of project implementation, while the concluding symposium in year five is scheduled to be held in Argentina.

#### **(e) Project Management, Mid-Term and Terminal Evaluation**

A mid-term review by a team of external specialists will be conducted in the third year of implementation. A terminal evaluation will take place towards the end of the project. The modality of the review and the evaluations will be agreed upon by the PEA, the Supervisory Body and the Fund. The information generated by the project will be used as much as possible. However, additional analysis of results may be required to draw lessons from implementation. The IASCAV, which will serve as the PEA will be provided support for planning, budgeting, coordination of implementation and for progress reporting and accounting. It will also carry out tri-country reviews on a regular basis to review boll weevil infestation in the region and provide guidelines for any improvement in implementation.

### **C. Benefits**

23. A successful introduction of a comprehensive package of integrated pest management for the control of the cotton boll weevil will have a substantial economic impact on the national economies of the three countries. According to the preliminary estimates, the production losses incurred due to the boll weevil infestation are estimated to be around 0.5 ton (seed cotton/ha). With an estimated total of 2.3 million ha. planted with cotton in the three countries (of which Brazil: 1.2 million ha., Argentina: 600,000 ha, and Paraguay: 500,000 ha.) the loss in production is estimated to be in the range of 1.15 million tonnes of seed cotton per annum, equivalent to 370,000 tons of lint/fibre. When valued at international prices this will amount to a loss of the equivalent of US\$ 600 million in revenue annually.

In addition to the losses in production, the presence of the boll weevil implies the need for additional use of pesticides which (on average) results in additional annual outlays of some US\$ 60 - 65/ha.

25. In Brazil and Paraguay the boll weevil infestation has resulted in reduction of areas planted to cotton. In North East Brazil, the area planted to cotton has dropped from 2.2 ha in 1980 to only 322,000 ha in 1992/93 due to boll weevil infestation. Reduction in yields and area cultivated is also expected in Paraguay where cotton production is mainly by smallholders' families estimated at 190,000 families. The proposed project if successfully implemented will mitigate against crop losses and assist in enhancing the family income of producers.

26. Whereas the direct economic losses due to the boll weevil infestation can be expressed in

quantifiable terms, the environmental impact is (in spite of its relevance) difficult to express in monetary terms. The health hazards associated with the spraying of toxic pesticides to control the boll weevil are well known. The small cotton producers who are mostly relying on family labour and taking no adequate safety precautions, are the most affected. The World Health Organization (WHO) estimated that about a quarter of workers poisoned by insecticides annually are due to cotton spraying. Furthermore, it has been proven that spraying of pesticides does not provide a longer term solution against the occurrence of the boll weevil. Resistance development reduces the effectiveness of the treatment, leading to the use of different, and often more toxic, pesticides. A third negative effect is that the pesticides used, do not only kill the targeted boll weevil but also kill natural biological control agents, a situation which has often resulted in increased pest attacks not only on cotton, but also on other crops. Such attacks lead to reduction in yields of crops other than cotton and increase cost of pest control. The smallholders are the most affected as they practice inter-crop and inter-plant as risk minimization strategy within their farming system. Lastly, it should be mentioned that pesticides constitute pollution hazards for both surface and ground water. It is envisaged that through the introduction of integrated pest management practices the overall need for spraying can be greatly reduced. In some regions, depending on the locational characteristics, it might even be possible to completely rely on IPM methods without the use of any pesticides. It is estimated that producers adopting the new technology will make gross increase in farm income of at least US\$ 180 equivalent per ha representing savings in cost of production and gross revenues from increased yield.

27. The three countries involved (Brazil, Argentina and Paraguay) will significantly benefit from the strengthening of capacities of their institutions in handling problems of IPM for boll weevil control. The intellectual gains will be applicable to other crops. The project also includes the sharing of knowledge and dissemination of technology developed to other countries in the region. Therefore, other cotton growing countries in the region will also derive institution strengthening benefits from the project, and this will be useful if boll weevil eventually spread to those countries. With the higher yields and lower production costs it is envisaged that the project will thus be instrumental in stimulating the increase of cotton production, as well as cotton processing and eventually its export. It can be reasonably expected that the project will have a positive economic impact at the micro, meso and macro economic level. Thus the country concerned will benefit from gains in employment, prevention of foreign exchange losses, and increase revenue from taxes. The studies, which are to be conducted at the beginning and towards the end of the project, should provide a fair picture of the impact of the project. In particular its impact on the many smallholder producers is of importance to measure the success of the project with regard to the socio-economic impact of the introduction of IPM. This is of crucial importance for Paraguay, where the production is significantly family-oriented, with an average farm-size of 2.4 ha. and where about two thirds of the rural population is involved in cotton production.

#### **D. Project Target Beneficiaries**

28. The immediate beneficiaries of the project outputs will be the cotton producers who will participate in the field trials and demonstrations as they will benefit directly from the resources made available through the project. Ultimately the cotton producers in general, of the three countries will benefit from the adoption of the technologies to be developed under the project. In Paraguay alone it is estimated that 190,000 smallholder families or about one million people will directly benefit. A large number of producers in Brazil and Argentina is expected. The project includes dissemination of technology to the other cotton producing countries in the region. Thus

the producers in these countries are potential beneficiaries in cases of boll weevil infestation. The local ginning factories (Paraguay has 46 ginning companies privately owned) will be major beneficiaries as they will also be assured of seed cotton.

### E. Project Costs and Financing

29. Project costs: The total costs for this five year project are estimated at about US\$ 8,213,170 million equivalent and includes a contingency provision of 5 %. The summary of the project costs is presented in table 1 below and details are shown in Appendix II, table 1.

**Table 1**

**Project Cost Summary  
(USD 000)**

Components	Total Cost	Component as % of Basic Cost
I. Evaluation of existing knowledge, and identification of functional elements useful for the development of location specific control packages, and definition of specific regional strategic plans	154.1	1.9
II. Study of the boll weevil and its associated cotton agroecosystems, including identification of its predators and parasites in the three countries	2,407.77	29.3
III. Development of pest management practices and systems based on the acquired IPM technology for the different production systems	3,029.46	36.9
IV. Transfer of technology to farmers, and extension staff	2,200.44	26.8
V. Project management, monitoring and evaluation	421.33	5.1
<b>Total</b>	<b>8,213.10</b>	<b>100.0</b>

30. Financing: Project costs would be financed by a grant of US\$ 1,971,280 from the Fund. Counterpart contributions totalling US\$ 6,241,890 will be available from Argentina (US\$ 2,326,290), Brazil (US\$ 2,564,960), Paraguay (US\$ 1,334,600) and ICAC (US\$ 16,040). The contributions provided by the counterparts cover approximately 76% of the total cost of the project. The summary of the proposed financing plan is reflected in table 2 below.

**Table 2**

**Financing Plan  
(US\$ 000)**

Component	CFC	Argentina	Brazil	Paraguay	ICAC	Total
I. Evaluation of existing knowledge and identification of fundamental elements useful for the development of location specific control packages, and a definition specific regional strategic plan	111.30	7.35	30.19	5.25	-	154.09
II. Study of the boll weevil and its associated cotton	444.12	760.65	766.17	436.84	-	2,407.78

agroecosystems, including identification of its predators and parasites in the three countries						
III. Development of pest management practices and systems based on the acquired IPM technology for the different production systems	433.51	1,009.39	1,002.21	584.36	-	3,029.47
IV. Transfer of technology to farmers, and extension staff	577.06	548.90	766.39	308.15	-	2,200.50
V. Project Management, Monitoring and Evaluation	405.29	-	-	-	16.04	421.33
<b>Total</b>	<b>1,971.28</b>	<b>2,326.29</b>	<b>2,564.96</b>	<b>1,334.60</b>	<b>16.04</b>	<b>8,213.17</b>
<b>% financed</b>	<b>24.00</b>	<b>28.00</b>	<b>31.00</b>	<b>16.00</b>	<b>1.00</b>	<b>100.00</b>

## **F. Procurement, Disbursement, Accounts and Audit**

31. Procurement would be in accordance with the Fund's Regulations and Rules for the Procurement of Goods and Services of the Second Account. Equipments, vehicles and materials would be bulked as much as possible to attract International Competitive Bidding. Contracts costing the equivalent of US\$ 100,000 or more would be subject to International Competitive Bidding. Contracts costing less than US\$ 100,000 equivalent, but more than the equivalent of US\$ 50,000 would be procured through local competitive bidding satisfactory to the Fund. For contracts costing US\$ 50,000 equivalent or less, or for specialized equipments, prudent shopping procedures (whereby at least three quotations are required) would apply. Contracts to be awarded to consultants/institutes will require prior agreement of the Supervisory Body which will ensure that the contracts are relevant and based on clearly defined Terms of Reference (TOR). The contracts will require clearance of the Fund prior to being awarded. The consultancy services under the project will follow internationally acceptable guidelines; consultants shall have experience and qualifications, and be recruited under conditions of service, satisfactory to the Fund.

32. Disbursements against the purchase of vehicles and equipments; and materials costing the equivalent of US\$ 1,000 or more, and consultancy services will be fully documented. Operating expenses, workshops and supplies will be disbursed against certified statements of expenditure (SOE). Documentation for withdrawals under SOE would be maintained in a central location by the PEA for review during supervision missions and for authentication by the auditors. Since the PEA and the collaborating institutions will not be in a position to pre-finance expenditures eligible for Fund financing, a Project Account will be opened by the PEA in a bank satisfactory to the Fund, and in convertible currency. The Fund will make an initial deposit of the equivalent of US\$ 190,000 equivalent to an estimated six months' worth of expenditures eligible for the Fund's financing. The Project Account will be replenished in accordance with the Fund's procedures for operating a Project Account. Based on agreed work programme and allocation of responsibilities, the PEA shall provide funds from the project account to collaborating institutions for the implementation of their part of the programme.

33. Accounts and Audit: The PEA and collaborating institutions will maintain independent and appropriate financial records and accounts in accordance with sound accounting practices. All project accounts, including the Project Account, will be audited annually, except otherwise agreed by the Fund, by independent auditors satisfactory to the Fund. The audited accounts and the auditors report, including separate opinions on SOE and the utilization of the funds in the Project Account, would be submitted within three months after the end of the related project's fiscal year.

## G. Organization and Management

34. The SB will ensure, prior to signature of the Project and Grant Agreements that the inputs of the collaborating countries are confirmed in the quantity foreseen under the project. IASCAV will be the Project Executing Agency (PEA) and will have the overall responsibility for the implementation of the project. IASCAV will be accountable for expenditures made under the project. For this purpose IASCAV will establish protocols with the collaborating institutions indicating clearly procedures for receipt of funds, expenditures including procurement guidelines, record keeping, accounting, financial statements preparation and audits. Establishment of such protocols will be a condition for disbursement by the Fund. The project management, including coordination of the planning and budgeting of the various activities as well as reporting on the progress achieved will be the responsibility of IASCAV. IASCAV will also assume overall responsibility for the project administration, including, *inter alia*, keeping of accounts, effecting or control of procurement, disbursements and audits. In order to assist the PEA in project administration a project manager will be provided. The PEA shall prepare the detailed Terms of Reference for the project manager. These TOR will require the clearance of the ICAC and the Fund, after which the project manager can be recruited.

35. The work programme and budget to be submitted to the SB and the Fund two months before the start of the execution of related programmes, shall cover in sufficient detail the activities to be carried out by each of the institutions involved and the task assignments for the key staff and consultants involved. The work programme shall also include a time schedule and a framework for the progress reports to be submitted to IASCAV. The draft work programme and budget will be reviewed and commented upon by the ICAC and made available to the Fund, for any comments it might have. Agreed-upon comments from the Fund and ICAC will be incorporated in the final work programme and budget. The representative of the PEA will chair a tri-national meetings which will meet regularly on agreed schedule, to discuss and assess efforts to control boll weevil in the region. The PEA will also be responsible for arranging the international workshops, preparing and disseminating the proceedings and organization of mid-term and terminal evaluation in consultation with the collaborating institutions, SB and the Fund.

36. The project execution and the day-to-day decisions will be the responsibility of the responsible national institutions namely, the Brazilian Enterprise of Agricultural Research (EMBRAPA) in Brazil, the Instituto Agronomico Nacional (IAN) in Paraguay, and the Instituto Nacional de Tecnologia Agropecuaria (INTA) in Argentina. The PEA, IASCAV, will provide an administrative linkage and maintain a coordinating structure with the Instituto Nacional de Tecnologia Agropecuaria, INTA, and the Provincial Government of Argentina; the Ministerio de Agricultura y Ganaderia of Paraguay; the Ministerio da Agricultura, do Abastecimento e da Reforma Agraria - Brasil Empresa Brasileira de Pesquisa Agropecuaria, EMPRAPA. The coordinating structure puts the work being conducted in each country under the leading institution responsible for the employment and support of participating scientists, technicians, and lecturers. These institutions will be directly responsible to IASCAV and the ICAC. The implementation schedule and work plans are set out in Appendices III and IV.

## **H. Monitoring, Reports and Supervision**

37. The PEA will submit annual progress reports on the achievements of the overall project. The PEA's reports (submitted to the ICAC and the Fund) will contain an assessment of the achievements in relation to the targets set (as reflected in the project document and the work programme). Variances will be accounted for and remedial actions will be proposed if required. Major constraints and problems which may hamper the achievements of the project objectives will be highlighted and suggestions to resolve them will be provided. The ICAC shall provide its comments on the report to the PEA and to the Fund. The Fund will carry out regular supervision of the project, such in co-ordination with the ICAC which will also carry out supervision in its capacity of Supervisory Body.

38. In the third year a mid-term review mission will be fielded, which will review the achievements of the project so far. At the end of the project, a terminal evaluation will take place. The actual timing of the review and evaluation missions, their composition and their TOR will be agreed upon by the PEA, ICB and the Fund. The PEA will develop and publish annually a report of progress and accomplishments for distribution to other cotton producing countries. At the end of year five, a Tri-National Symposium will be held in a participating country to highlight the accomplishments of the project and to present the results before international audience of scientists and farmers.

39. The PEA will make necessary arrangements for the publication and distribution of relevant research findings in at least two languages (English and Spanish). The PEA will prepare a Project Completion Report to highlight the project achievements, constraints and experiences gained in the design and implementation of the project. The PCR, along with the final accounts and audit, will be submitted not later than three months after the completion of the activities.

## **I. Risks**

40. Inherent to a research and development project is the risk that the objectives of the project cannot be achieved due to disappointing technical and scientific results. Although this risk can not be completely neutralized, it is minimized by the fact that most of the basic research works have been done and effectiveness of technology tested in Mexico, North and Central America. The project will build on these past efforts, expand the scope and adjust known technology to the socio-economic situation and production systems in the countries concerned.

41. Achievement of the objectives of the project will, to a large extent, be contingent on effective coordination of implementation of the research and development activities by the various participating institutes in Argentina, Brazil and Paraguay. This requires carefully prepared organizational arrangements, a detailed agreed upon research agenda, and a flexible, but carefully adhered to, implementation and reporting schedule. All these requirements are included in the design of the project. Collaboration between institutions concerned have been already established and will be further strengthened by the project.

The PEA (IASCAV) has been involved in coordinating efforts for the control of boll weevil in the region. However, the project requires more intensive work and a higher level of coordination involving programming and financial control. Therefore, the PEA is supported by a small project support office consisting of a project manager, assisted by two support staff.

42. Another risk is that legal or policy difficulties could arise from the collaborating countries, which may make the project implementation difficult. A related risk may be that the collaborating countries may have financial difficulties which may create difficulties in providing their contribution to project financing. These risks are minimized by the firm commitment of the countries to supporting the project. This commitment arises from the importance of cotton to the economy of the three countries. Further, this commitment will have to be confirmed before the Fund will undertake the first disbursement of its own contribution. There is the risk that farmers may not adopt the technologies developed. This risk will be minimized by involving the producers in planning, trials, and demonstration of the technology. Further, extension specialists and agents form an integral part of the project team which will develop and disseminate the technologies.