

FIGURE 16
Appearance of large fish cages on RADARSAT-1 SAR data

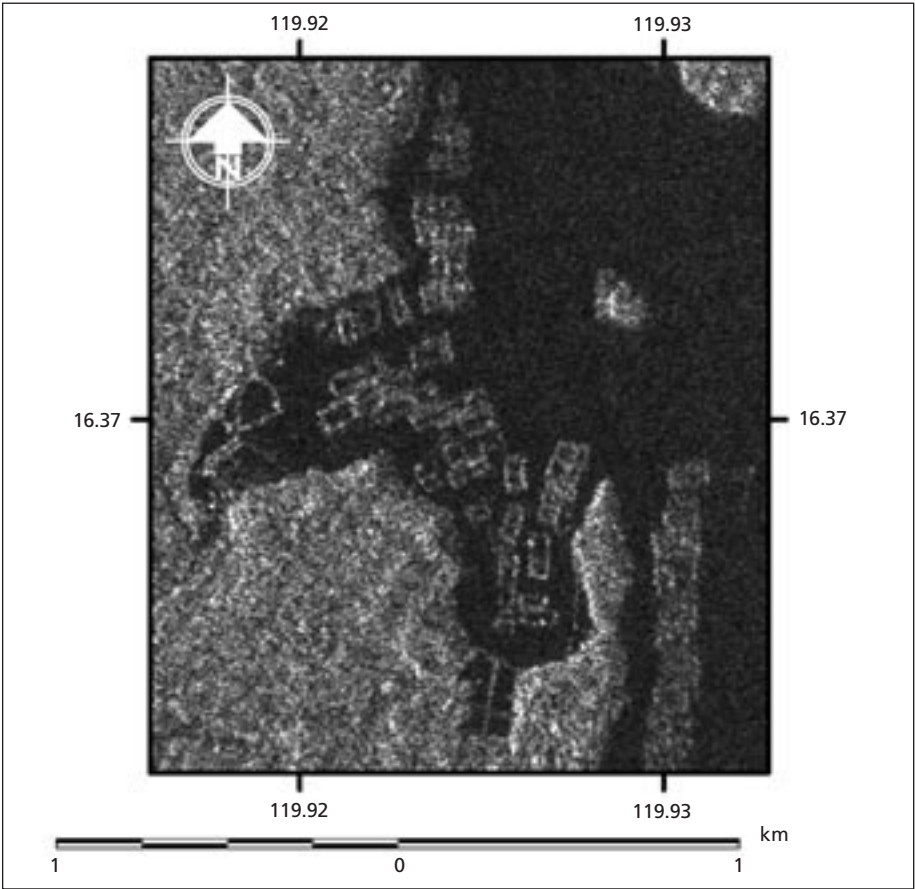


FIGURE 17
Appearance of offshore fish traps on the RADARSAT-1 SAR image

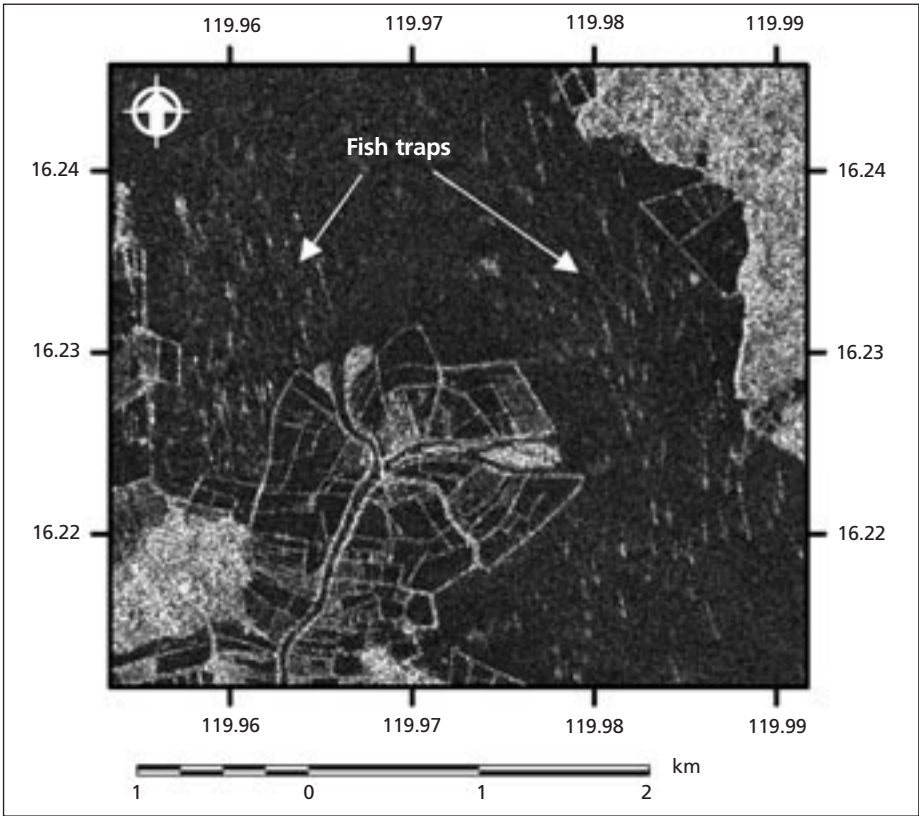
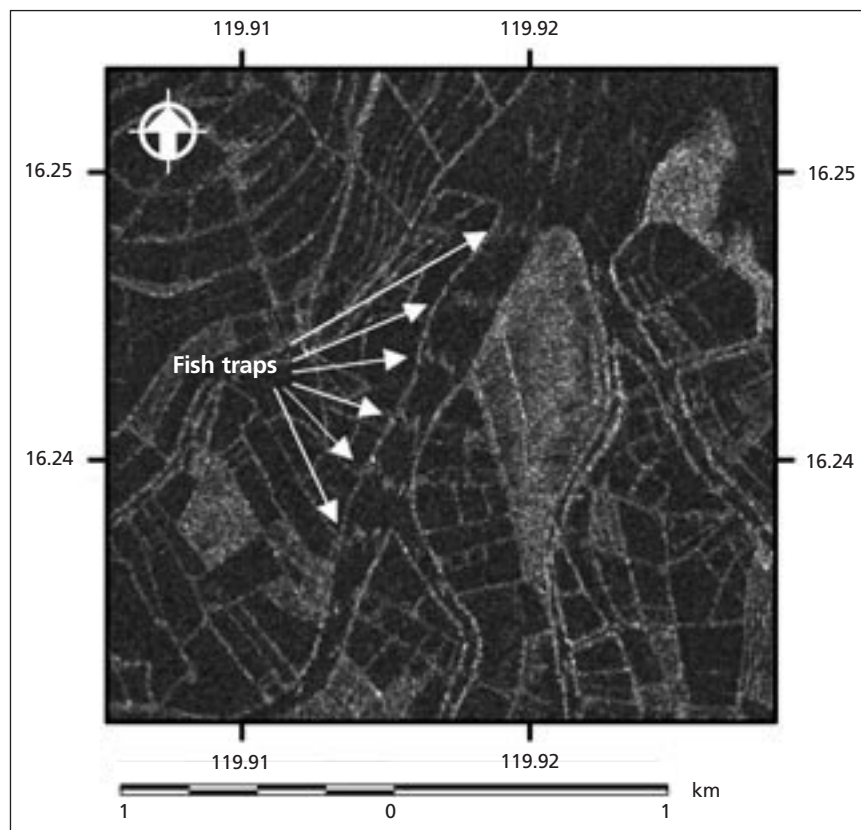


FIGURE 18
Appearance of fish traps inside rivers on the RADARSAT-1 SAR image



3.5 LAND COVER CHANGES

By comparing the results of the SAR mapping with the 1977 cartography, some interesting observations can be made.

The 58.2 percent of the present fishponds occupy areas which were already devoted to aquaculture in 1977. The new fishponds (31.5 percent) are mainly located on former agricultural land.

In contrast, only 6 percent of the land covered by fishponds in 1977 has now a different use. This can also be a direct consequence of the evolution between 1977 and 2002 of the drainage network, the major rivers having noticeably changed their course with subsequent flooding and siltation phenomena.

3.6 FIELD VERIFICATION EXERCISE

A team of the BFAR went in December 2003 to Lingayen Gulf to check the accuracy of the mapping results. They were equipped with all the necessary tools (GPS, compass, digital cameras, topographic maps and SAR mapping results at 1:50 000 scale) and checked the interpretation of SAR images. Before discussing the field validation results, the following aspects of the work should be considered:

1. Fish traps were recognized only on RADARSAT data which were acquired on February 2001, that is about two years before the field check. Some of them could have been removed or moved somewhere else in this timeframe;
2. Fish cages were easily mapped with both RADARSAT-1 and ERS-2 data. As the cages are floating, they can be moved to other places if there is a need. Actually, a group of cages located between Luzon Island, Santiago Island and Cabarruyan Island presents two distinct locations in RADARSAT-1 (February 2001) and in ERS-2 (December 2002), most probably as a consequence of a typhoon (Figure 14). Thus the field checking of fish cages was limited to ascertaining the presence of fish cages in the vicinity of the place indicated in our SAR-derived maps, as in a one year

interval the cages could have been moved somewhat. However, in the majority of the cases, the fish cages were still at the places mapped from radar data.

3. Fish pens and fishponds, being semipermanent structures, were not influenced by the one year time interval and thus they were field checked at the exact coordinates reported in the radar-derived maps. In limited cases fishponds were converted to other uses in the most recent months, but interviews with local people confirmed their original nature.

The field work was thus aimed at mainly verifying the interpretation of fishponds and fish pens. The survey was conducted on 32 verification points, selected by means of a two-stage cluster sampling scheme (Figure 19). Some verification points were also located on the “fishponds, uncertain” class, as the results could have assisted in fine-tuning the interpretation keys. The results of the ground truth on the verification points and the corresponding visual interpretation are described in Table 8.

The ground verification included also six observation points located offshore and inside rivers, in order to confirm the presence of fish cages and traps in/or the proximity of the points in which they are located in the SAR images.

The analysis of the ground truth at the verification points shows that both the two points located on the class “fishponds, uncertain” are in fact other types of water-covered surfaces. This confirms the correctness of the main interpretation key, according to which the water-covered surfaces were assigned to the class fishponds only if the surrounding dykes were visible. Water-covered surfaces regular in shape but not surrounded by visible dykes were assigned to the class “fishponds, uncertain”; the results of the ground survey demonstrate that the class “fishponds, uncertain” should be removed from the final map.

Of the other 30 verification points, 23 are located on areas interpreted as fishponds, four on fish pens and three on salt pans. The actual land use was different at one point only; it had been assigned to fishponds by the visual interpretation, but the corresponding area is a marshland bordering salt pans.

The user's accuracy of the verified classes, e.g. the ratio between the total number of points truly belonging to a class and the total number of points assigned to the same class by the visual interpretation procedure, is thus 100 percent for salt pans and fish pens, and 95.7 percent for fishponds. These figures give the probability that a point on the interpretation map truly corresponds to the class to which it has been assigned. However, the actual accuracy of the “salt pans” class might be lower, due to the fact that they may appear very similar to fishponds when they are completely flooded.